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ALTERNATIVE FUELS COMPATIBILITY WITH ARMY EQUIPMENT TESTING – EFFECTS OF JP-8+100 ON MILITARY FILTRATION EQUIPMENT

INTERIM REPORT
TFLRF No. 424

by
Gary B. Bessee

U.S. Army TARDEC Fuels and Lubricants Research Facility
Southwest Research Institute® (SwRI®)
San Antonio, TX

for
U.S. Army TARDEC
Force Projection Technologies
Warren, Michigan

Contract No. W56HZV-09-C-0100 (WD15 & WD36)

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14. ABSTRACT

The GE 8Q462 thermal stability fuel additive (known as +100) has been in use for the past decade. Questions still arise if this additive "poisons" the fuel water separators. Since the U.S. Army uses the "singe fuel (JP-8) on the Battlefield" concept, the normal filters that would be in the field include the DoD elements and/or the EI 1581 5th Edition M category elements. If JP-8+100 are used in the field, the approved filtration system would be the EI 1581 5th Edition A4 category elements. This research was to determine the amount of blend back required for defueling JP-8+100 using EI 1581 5th Edition M category coalescer/separators. Due to issues in the initial research, subsequent research was funded to verify the dilution ratio required for filtering +100 fuel with EI 1581 5th Edition M category filtration. No conclusive dilution recommendation could be made based on the sporadic test results. In addition the filtration research, electronic sensor data was obtained during the filtration evaluations to recommend an ISO 4406 cleanliness code for inline particle counters.

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EXECUTIVE SUMMARY

A modified EI 1581 5th Edition protocol was used to determine the blend back requirements for defueling JP-8+100. DoD and EI 1581 5th Edition M category test elements were used to determine the required blend back dilution ratio. The test method modified the dirt loading to simulate half the filter life (approximately 7 psid) instead of loading the filter past the normal terminating pressure of 15 psid.

As the test results for both the DoD and EI 1581 5th Edition M category filtration systems was sporadic, no recommended dilution can be provided. Evaluations had passing results or close to passing results at the recommended dosage and failures at most dilution levels. There was no consistency in these evaluations that can support a recommendation.

Particle counting data was obtained during all of the evaluations to generate data to recommend the fuel cleanliness level using online sensors instead of gravimetric and Aqua-glo measurements. ISO 4406 Cleanliness Code is the industry standard for determining the fluid cleanliness level. This standard provides a code for 4-, 6, and 14-µm (c). Since water contamination is a major issue for fuel quality, it was recommended to add 30-µm (c) as any free water will be relatively large particle. The recommended ISO 4406 cleanliness code for online particle counters is 19/17/14/13.

FOREWORD/ACKNOWLEDGMENTS

The U.S. Army TARDEC Fuel and Lubricants Research Facility (TFLRF) located at Southwest Research Institute (SwRI), San Antonio, Texas, performed this work during the periods December 2010 through February 2012 and August 2014 through December 2015under Contract No. W56HZV-09-C-0100. The second period of research was due to requiring further research to determine the objectives of the program. The U.S. Army Tank Automotive RD&E Center, Force Projection Technologies, Warren, Michigan administered the project. Mr. Luis Villahermosa (RDTA-SIE-ES-FPT) served as the TARDEC contracting officer's technical representative. Mr. David Green, Mr. Eric Sattler, Mr. Kenneth Walther, and Mr. Joel Schmitigal of TARDEC served as project technical monitors.

The authors would like to acknowledge the contribution of the TFLRF technical and administrative support staff.

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ACRONYMS AND ABBREVIATIONS

TFLRF	TARDEC Fuels & Lubricants Research Facility
EI	Energy Institute
DoD	Department of Defense
SDA	Static Dissipator Additive
CI	Corrosion Inhibitor
FSII	Fuel System Icing Inhibitor
MSEP	Micro Separometer
AO	Anti-Oxidant
MDA	Metal Deactivator Additive
CI/LI	Corrosion Inhibitor/Lubricity Improver
WSIM	Water Separation Index Measure
NSN	National Stock Number
API	American Petroleum Institute
DESC	Defense Energy Support Center
DOE	Design of Experiment
DiEGME	Diethylene Glycol Monomethyl Ether
ASTM	American Standards for Testing and Material
ISO	International Standards
IP	Institute of Petroleum

1.0 OBJECTIVE

The objective of this program was to determine the proper dilution ratio for blend back defueling operations to avoid deleterious effects on performance of military filtration equipment. TFLRF will evaluate both EI 1581 5th Edition M category and DoD filter elements per a modified EI 1581 5th Edition protocol.

2.0 INTRODUCTION AND BACKGROUND

2.1 BACKGROUND ON THE DEVELOPMENT OF THE +100 THERMAL STABILITY ADDITIVE

Military aviation fuels contain certain additives to meet the severe operational requirements. The typical fuel additives include static dissipator additive (SDA), corrosion inhibitor (CI), and fuel system icing inhibitor (FSII). The GE 8Q462 thermal stability additive has been used in various applications since 2000 to increase the thermal stability of the aviation fuel and has been designated as +100, as it increases the thermal stability by 100 °F. The +100 fuel additive has been thought to “poison” coalescers and separators.

The following is a summary provided by Larry Dipoma on the historical background relative to the development of the T.O. 42B-1-1 requirement for a 1 to 100 ratio for blending JP-8+100 into bulk JP-8. While serving on Air Force active duty, he was one of a small number of individuals involved in the development and implementation of both the static dissipater additive (SDA) and the +100 thermal stability additive. Following his retirement from the Air Force, he worked on the +100 program as a consultant and developed the implementation plan for the rapid expansion of JP-8+100 to fighter and trainer aircraft [1].

Some background regarding the other additives in JP-8 is essential to understanding the decision to require a 1 to 100 blend back ratio of JP-8+100, and to recognize that a change to the current policy may be called for. All of the additives used in JP-8 have some impact on the ability to separate water from the fuel. They are surface active agents (surfactants) that can, in sufficient

quantity, inhibit the ability to coalesce water into large droplets so the water droplets can be separated from the fuel. During the 1980s and early 1990s, a Water Separation Index Measure (WSIM) test was used to monitor the impact of individual additives and combination of additives to ensure the ability to separate water from fuel. In more recent years, the WISM test method was replaced by the Microseparometry (MSEP) (ASTM D-3948) [2] rating.

The ASTM-D-1655 [3] specification for JP-8 requires that:

> "The minimum MSEP rating for JP-8 shall be: (a) **90** with antioxidant (AO) and metal deactivator (MDA), (b) **85** with AO, MDA and FSII, (c) **80** with AO, MDA, and CI/LI, and (d) **70** with AO, MDA, FSII and CI/LI."

Note that there is no MSEP rating required following the injection of static dissipater additive (SDA): this is because the addition of SDA to the fuel causes a significant and highly variable drop in both the WSIM and the MSEP rating. Consequently, a decision was made to ensure that the JP-8 with the other required additives had a minimum WISM or MSEP rating of 70 prior to adding the SDA. After SDA was added, a water separation rating would not be required—what you can't see, won't hurt you. In short, with the addition of SDA to the JP-4/JP-8 specification, the Air Force fuel quality community felt that the amount of surfactant additives in JP-8 had been pushed as far as they dared to go—and perhaps even farther than reason would dictate. In fact, the high failure rate of the DoD NSN 4330-00-983-0998 filter/coalescer elements during this period prompted the Air Force to initiate a program to replace the DoD standard vessels with filter-separator vessels and elements that comply with the American Petroleum Institute (API) Specification 1581 [4] for filter-separators used by the commercial aviation industry. It also caused the Air Force to work with the API to include a surfactant requirement in the qualification testing for filter/coalescer elements.

The +100 additive consists of four major components: a detergent, a dispersant, a metal deactivator, and an antioxidant. By definition a detergent is "surface-active." Because of the concern that the addition of any other surfactant additives to JP-8 would destroy the ability of filter-separators to separate water from the fuel, special precautions were deemed necessary for

the handling of JP-8+100. The +100 additive would be injected downstream of the truck fill stand filter-separators, and the filter-separator elements in the truck filters would be replaced by water absorbent elements. Furthermore, any JP-8+100 that must be blended back into the JP-8 storage system would be blended with a ratio of 1 part of JP-8+100 to 100 parts of JP-8. Why a blend back ratio of 1 to 100? The answer is quite simply that precedence has been set for using the 1 to 100 ratio for blending other products into JP-8. Diesel fuel, automotive gasoline, mixed turbine fuels, and JP-4 may all be blended into bulk JP-8 provided the ratio does not exceed 1 part to 100 parts of JP-8. Less restrictive blend ratios are allowed for other products that might be blended with JP-8:

FROM	BLENDING RATIO	TO
Jet A	One to Four	JP-8
Jet A-1	One to Four	JP-8
JP-5	One to Four	JP-8
JP-7	One to Four	JP-8
JPTS	One to One	JP-8
JP-10	One to Ten	JP-8

Minimal testing was accomplished to confirm that the 1 to 100 blend back ratio for JP-8+100 would not adversely impact JP-8; however, no testing was conducted to determine if a lower blend back ratio would be feasible.

2.2 EI 1581 4TH EDITION HISTORY

In the development of the API/EI 1581 4th Edition [5], a test fuel chemistry was developed to challenge filter-water separator design in terms of surfactant resilience. This was done as a response to user demands to produce equipment that was less prone to surfactant disarming in the field. The test fuel chemistry that was chosen contained additives reflecting the end use, civil or military, together with a small amount of a known potent surfactant, Petronate L (a sodium naphthasulphonate). The actual additive packages are described in Table 1.

Table 1. Summary of Proposed Additive Packages for API/IP 1581 4th Edition

API/EI 1581 Test Category	Application	Test Fuels Additive Content
C	Civil Aviation	1.0mg/l Stadis 450, 2.9 mg/l Hitec E-580, 0.4 mg/l Petronate L
M	Military fuels	2.0mg/l Stadis 450, 15 mg/l DCI4A, 0.2% v/v FSII, 0.4 mg/l Petronate L
M100	Military fuels containing +100 additive	2.0mg/l Stadis 450, 15 mg/l DCI4A, 0.2% v/v FSII, 256 mg/l +100, 0.4 mg/l Petronate L

It was assumed (but with no direct evidence), that because of the nature and levels of additives in the test fuels that M100 would constitute the most challenging surfactant chemistry for water separation and C the least. Consequently a system of cascading qualifications by similarity was defined as follows:

- Qualified M100 equipment automatically qualifies for M and C
- Qualified M equipment automatically qualifies for C

  Or
- M100>M>C.

Within months of the publication of this standard, one equipment supplier was already reporting a gross anomaly. His newly qualified M100 equipment could not operate correctly in C category fuels – because of the potency of the Petronate L. At that time the possibility of additive interactions was not discussed and the relevant API/EI working group resolved the anomaly by publishing a 5th Edition in which Petronate L was removed from the test fuel additive requirements. Furthermore, the hierarchy of surfactancy challenge M100>M>C was removed so that all single element testing had to be carried out for each category.

Traditionally, API/IP maintain the aviation fuel related specifications. In 2010, API/IP informed the aviation industry they would no longer support or maintain the aviation fuel related specifications. At this time, the Energy Institute (EI) assumed the responsibility for these aviation fuel-related documents.

2.3 +100 THERMAL STABILITY RESEARCH PROGRAM

A cooperative research program was organized to perform a systematic program for determining the effects of the +100 thermal stability additive and the other additives used in JP-8. This program involved several of the major oil companies, GE Betz (the +100 additive supplier), DESC, U.S. Air Force, and the ministry of Defense (UK). A design of experiment (DOE) was prepared so any conclusions were statistically sound.

Based upon the statistical analysis utilizing the failure criteria agreed upon by the program members (water by Aqua-glo greater than 10 ppm free water and solids by gravimetric membrane greater than 0.5 mg/L), the following conclusions can be made:

- For 3rd edition elements, the average maximum Aqua-glo for JP-8 (34.25) is significantly greater than the average at JP-8+100 @256 ppm (6.50) during the 100 ppm water challenge.
- There is no statistical difference in the average maximum Aqua-glo between JP-8 and JP-8+100@256 ppm for the EI 1581 5th edition M100 category elements at the 100 ppm water challenge or the 0.5% water challenge.
- There is no statistical difference in the average maximum Aqua-glo between JP-8 and JP-8+100@256 ppm for the API/IP 3rd edition elements at the 0.5% water challenge.
- For both the API/IP 3rd Edition and EI 1581 5th edition M100 category elements, there is no significant difference in the average maximum differential pressure between JP-8 and JP-8+100@256 ppm at either the 100 ppm or 0.5% water challenge.

Thus the overall conclusion is there is no fundamental difference in the average filtration performance between JP-8 and JP-8+100@256 ppm. Any portion of the test matrix where the JP-8 failed, the equivalent JP-8+100 test failed at the same time or later in the test protocol.

Based on these results, it is concluded that JP-8+100 does not require dilution for JP-8+100 fuel returned to bulk storage.

Based upon the statistical results and resulting regression models, the Phase II conclusions of this program included:

- The corrosion inhibitor (DCI4A) has detrimental effects on water removal performance at the 0.5% water challenge. All five tests that passed the Aqua-glo limits contained no CI/LI. CI/LI also had detrimental effects on filtration performance with respect to maximum differential pressure at the solids test phase.
- The fuel system icing inhibitor (DiEGME) has detrimental effects on water removal performance at the 100 ppm water challenge. All four test failures by Aqua-glo limits contained FSII at 2000ppm. FSII was not a significant factor in any of the response surface models for the solids test phase.
- The GE 8Q462 thermal stability additive (+100) does not affect the filtration performance for either water or solids. During the 100 ppm water challenge, increases in +100 resulted in decreases in the maximum Aqua-glo. All of the four test failures at 100 ppm contained no +100 additive. At the 0.5% water challenge, +100 was not a significant factor. Of the five tests that were under the Aqua-glo limit (i.e.; passes), two had no +100 and the other three contained the +100 additive.

As with the initial phase of this research, the +100 demonstrated it did not “poison” the EI 1581 5th Edition M100 category filtration system.

Based on the initial cooperative R&D results, the U.S. Army funded a follow-on program to determine if initial conclusions that DCI 4A corrosion inhibitor was detrimental to water removal performance [6]. Due to funding constraints, only a small test matrix was performed at various concentrations to make this determination. In addition to the Aqua-glo analysis, particle count and turbidity data were used to verify the conclusions. The only variable in the test matrix was the DCI 4A concentration. All data supports the conclusion that the lower the DCI 4A corrosion inhibitor concentration, the less impact this additive has on water separation performance. Results with only static dissipater (Stadis 450) and fuel system icing inhibitor (Di-EGME) generate data similar to Jet A which contains no additives.

3.0 TEST PLAN

TFLRF evaluated both EI 1581 5th Edition M category and Department of Defense (DoD) (I-420MMA (NSN 4330-01-477-7985), aviation fuel coalesce/separators using a modified version of EI 1581 5th Edition. It is noted that the DoD elements are qualified per MIL-PRF-52308J for only JP-8; NOT JP-8+100. The EI 1581 5th Edition M100 elements are qualified using JP-8+100. The only modification to the EI 1581 5th Edition test method was performing the solids section until the differential pressure reached approximately half the filter life (7 psid), instead of challenging the test filters for the entire 75 minutes and having a differential pressure outside the operating parameters for the filtration system. All other sections of the EI 1581 5th Edition test protocol remained unchanged. Also, note the EI 1581 5th Edition test filters used for these evaluation are qualified for JP-8 and not JP-8+100. The contaminant challenge and test time each section is shown below:

- 100-ppm water – 30 minutes
- 90 wt% ISO 12103-1 A-1 Ultra Fine Test Dust/10 wt% Red Iron Oxide (RIO) – Test until the differential pressure (DP) reaches approximately half the recommended filter life (7 psid)
- 100-ppm water – 150 minutes
- 3% water – 30 minutes

Both the DoD and EI 1581 5th Edition M category elements were purchased from the same manufacturer and each type of filter ordered from the same batch in an attempt to eliminate any variation in the production of the elements. Both the DoD and EI 1581 5th Edition M category elements were evaluated in the following order:

- JP-8
- JP-8+100 (256-ppm +100 additive) (recommended dosage)
- JP-8+100 (40:1 dilution – 6.4 ppm +100 additive)
- JP-8+100 (20:1 dilution – 12.8 ppm +100 additive)
- JP-8+100 (10:1 dilution – 25.6 ppm +100 additive)
- JP-8+100 (5:1 dilution – 51.2 ppm +100 additive)
- JP-8+100 (1:1 dilution – 128 ppm +100 additive)

In addition to the Aqua-glo and gravimetric data required by EI 1581, particle counting and other electron sensor data was obtained to compliment the tradition data and to provide additional information for *Alternative Fuels Compatibility with Army Equipment Testing – Inline Monitoring* report. The other electronic sensors included a Faudi Avguard, Sigrist DualScat Ex turbidimeter and an OptekTF-16ex turbidimeter. For this report, the D2 water detector was used instead of the Gammon Aqua-glo. It is approved by ASTM and provides higher and lower readings than the Gammon Aqua-glo that is limited to 12-ppm without taking a partial sample.

As shown below, the original test results exhibited failures at the 3% water challenge for all of the EI 1581 5th Edition element tests. Evaluation of the filtration system and discussions with the filter manufacturer, it was determined that the separator had possible knife edge sealing issues. Therefore, additional funding was obtained for re-testing the EI 1581 5th Edition elements with the improved sealing for the separators. Instead of duplicate tests, only single tests could be performed due to the available funding. The revised test matrix for the EI 1581 5th Edition elements are shown below:

- JP-8
- JP-8+100 (256-ppm +100 additive)
- JP-8 +100 (40:1dilution – 6.4 ppm +100 additive)
- JP-8 +100 (20:1dilution – 12.8 ppm +100 additive)
- JP-8+100 (10:1 dilution – 25.6 ppm +100 additive)
- JP-8+100 (5:1 dilution – 51.2 ppm +100 additive)
- JP-8+100 (1:1 dilution – 128 ppm +100 additive)

It is noted that the 1:1, 5:1, 10:1, 20:1, and 40:1 dilution evaluations were performed using a new batch of +100 additive. The new +100 additive had a different color, odor and consistency. The lot number for GE SPEC-AID 8Q462 for the new evaluations was 8091515456. This change in +100 supply could have had caused significant issues with the particle count data for these five evaluations.

4.0 TEST RESULTS

A summary of the test results are provided in Table 2 for the DoD elements. NSN 4330-01-477-7985 elements were used for this testing, which are qualified per MIL-PRF-52308J for JP-8, not JP-8+100. The highest contamination value for each test section is provided in the appropriate table with values out of specification listed in red. All of these evaluations were performed with the original batch of +100 additive. The complete data sheets for all the evaluations are provided in Appendix A.

Table 2. Summary of DoD Test Results

Test Fuel	Initial 100 – ppm Water Challenge, ppm	Solids Challenge, mg/L	Second 100 –ppm Water Challenge, ppm	3% Water Challenge, ppm
JP-8	1.2	0.125	2.3	5.2
JP-8	<1	0.125	<1	2.3
JP-8	<1	0.125	1.5	1.5
JP-8	<1	0.125	1	16.2
JP-8+100 (256 ppm)	1.0	0.225	2.3	7.5
JP-8+100 (10:1 dilution)	1.2	0.05	2.6	6.7
JP-8+100 (10:1 dilution)	<1	0.05	<1	5
JP-8+100 (5:1 dilution)	2.8	0.125	4.7	37.1
JP-8+100 re-run (5:1 dilution)	1.1	0.075	4.8	Off-scale
JP-8+100 (1:1 dilution)	2.8	0.05	2.1	Off-scale

The summary of all of the EI 1581 5th Edition M category test results (original Work Directive), EI 1581 5th Edition M category test results (new Work Directive, old batch of GE SPEC-Aid 8Q462), and EI 1581 5th Edition M category test results (new Work Directive; new batch of GE 8Q462) are shown in Table 3, 4, and 5, respectively.

Table 3. Summary of EI 1581 5th Edition M Category Test Results – Original Research with Possible Knife-Edge Sealing Issues

Test Fuel	Initial 100 – ppm Water Challenge, ppm	Solids Challenge, mg/L	Second 100 –ppm Water Challenge, ppm	3% Water Challenge, ppm
JP-8	0.5	0.10	0.7	41.8
JP-8	1.3	0.10	1.9	5.9
JP-8+100 (256 ppm)	1.0	0.125	2.0	40
JP-8+100 (256 ppm)	0.1	0.025	0.2	45.2
JP-8+100 (1:1 dilution)	0.3	0.075	0.6	42.5
JP-8+100 (1:1 dilution)	2.8	0.050	2.1	Off-scale
JP-8+100 (5:1 dilution)	1.1	0.05	4.8	Off-scale
JP-8+10 (10:1 dilution)	0.8	0.125	1.6	17.9
JP-8+100 (10:1 dilution)	0.8	0.125	1.7	Off-scale
JP-8+10 (10:1 dilution)	0.2	0.05	0.5	42.1

One JP-8 evaluation using the filtration coalesce/separators that had the possible “bad knife-edge” sealing experienced a failure. The test performed as expected all the way to the 20 minute stop/start where the free water content was 12.8 ppm. Nothing appeared to be different in the performance of the filtration system as the differential pressure was within the expected range. The 30 minute free water was 41.8 ppm illustrating the filtration did fail and this data wasn’t an outlier. Since there were other issues with the knife-edge sealing, it can only be suspected that this might have been the cause for this failure too.

Table 4. Summary of EI 1581 5th Edition M Category Test Results – Follow-on Research with New Coalescer/Separators and Old Batch of GE SPEC-Aid 8Q462

Test Fuel	Initial 100 – ppm Water Challenge, ppm	Solids Challenge, mg/L	Second 100 –ppm Water Challenge, ppm	3% Water Challenge, ppm
JP-8	1.4	0.060	2.4	2.1
JP-8+100 (256 ppm)	2.2	0.140	10.2	14.9

Table 5. Summary of EI 1581 5th Edition M Category Test Results – Follow-on Research with New Coalescer/Separators and New Batch of GE SPEC-Aid 8Q462

Test Fuel	Initial 100 – ppm Water Challenge, ppm	Solids Challenge, mg/L	Second 100 –ppm Water Challenge, ppm	3% Water Challenge, ppm
JP-8+100 (1:1 dilution)	0.9	0.150	1.8	41.5
JP-8+100 (5:1 dilution)	7.3	0.075	2.7	Off-scale
JP-8+100 (10:1 dilution)	0.4	0.075	1.8	43.1
JP-8+100 (20:1 dilution)	0.2	0.075	0.5	43.0
JP-8+100 (40:1 dilution)	0.2	0.100	1.1	43.7

The EI 1581 5th Edition evaluations using the M category elements determined the dilution ratio needs to be greater than 40:1. However it is also noted that there appears to be differences between the old and new SPEC-AID 8Q462 batches utilized for this testing. Further analysis is presented in Section 5.0 – Particle Counting and Electronic Sensors that demonstrated the differences.

5.0 PARTICLE COUNTING AND ELECTRONIC SENSORS

The particle counters utilized for this research included the Parker ACM20 (for most of the research), Parker IOS (only a few of the new tests), the Parker iCount (worked sporadically), and the Seta AvCount (the last 7 evaluations). The other electronic sensors included a Faudi AvGuard, Sigrist DualScat Ex turbidimeter and an OptekTF-16ex turbidimeter. The other electronic sensors are used for reference only and are not calibrated to any known specification and often only the electronic signal is recorded to determine the response factors. Although not quantitative, the electronic sensors are able to provide additional information on the filtration performance. A comparison of these sensors technology and pro/cons is provided in Table 6.

Table 6. Electronic Sensor Comparison

Electronic Type of Sensor	Manufacturer	Technology	Sampling	Advantages	Disadvantages	Limitations
ACM 20 automatic particle counter	Parker	Light Extinction/ Obscuration	On-line	Light Extinction gives good correlated data in the form of particles counts and sizes. Particle counting is a mature technology that has been utilized in the hydraulic industry for decades. Industry standards are available for use and calibration. Good industry defined traceability. Industry recognized standard cleanliness codes – ISO 4406 Continuous, real-time readings and provides actual counts/mL	Side-stream format requires representative sampling add-on. Does not differentiate between contaminant types indirectly e.g., dirt and water, or other contaminants. (skewed distribution data can infer presence of water droplets) Calibration probably requires removal from the refueling vehicle and calibrated in-house or at an outside laboratory.	Currently, the industry cannot differentiate between particulate and water. Current technology can only measure as low as 4-µm (c) Requires a constant flow rate as output is reported as counts/millilitre (mL) and the volume is critical to the accuracy of the results. Particle counting results cannot be correlated to gravimetric results
iCount	Parker	Light Extinction/ Obscuration	On-line	Light Extinction gives good correlated data in the form of particles counts and sizes. Particle counting is a mature technology that has been utilized in the hydraulic industry for decades. Industry standards are available for use and calibration. Good industry defined traceability. Industry recognized standard cleanliness codes – ISO 4406 Go for Go/No Go operations Small and light weight	Side-stream format requires representative sampling add-on. Does not differentiate between contaminant types indirectly e.g., dirt and water, or other contaminants. (skewed distribution data can infer presence of water droplets) Calibration probably requires removal from the refueling vehicle and calibrated in-house or at an outside laboratory.	Currently, the industry cannot differentiate between particulate and water. Current technology can only measure as low as 4-µm (c) Requires a constant flow rate as output is reported as counts/millilitre (mL) and the volume is critical to the accuracy of the results. Particle counting results cannot be correlated to gravimetric results
AFGuard	Faudi	Light Scatter -	In-line	No industry standards for	Requires algorithm to convert	Large sensor unit requires major

Table 6. Electronic Sensor Comparison

Electronic Type of Sensor	Manufacturer	Technology	Sampling	Advantages	Disadvantages	Limitations
		turbidity		reference for calibration Flexible interfacing Continuous real-time use Seems to have good correlations determining free water content Could be good for a Go/No go application (depending upon accuracy of the algorithm)	NTU values to ppm. Accuracy of results depends on how the algorithm is written. Does not differentiate between contaminants, e.g., dirt , water, or other contaminants Droplet size can influence the results Specific industry protocols require the development of a sensor specific for aviation fuel No industry standards for calibrating light scattering instruments	changes to existing pipe work – in some cases may not be possible
DualScat Ex	Sigrist	Light Scatter - turbidity	In-line	No industry standards for reference for calibration Flexible interfacing Continuous real-time use Seems to have good correlations determining free water content	Only provides data in NTU values Does not differentiate between contaminants, e.g., dirt , water, or other contaminants Droplet size can influence the results Specific industry protocols require the development of a sensor specific for aviation fuel No industry standards for calibrating light scattering instruments	Large sensor unit requires major changes to existing pipe work – in some cases may not be possible
TF-16-Ex	Optec	Light Scatter - turbidity	In-line	No industry standards for reference for calibration	Requires algorithm to convert NTU values to ppm. Accuracy of	Large sensor unit requires major changes to existing pipe work – in

Table 6. Electronic Sensor Comparison

Electronic Type of Sensor	Manufacturer	Technology	Sampling	Advantages	Disadvantages	Limitations
				Flexible interfacing Continuous real-time use Seems to have good correlations determining free water content Could be good for a Go/No go application (depending upon accuracy of the algorithm)	results depends on how the algorithm is written. Does not differentiate between contaminants, e.g., dirt , water, or other contaminants Droplet size can influence the results Specific industry protocols require the development of a sensor specific for aviation fuel No industry standards for calibrating light scattering instruments	some cases may not be possible

Selected particle count and other electronic sensor data is provided in Appendix B and C, respectively.

Table 7 provides the ISO 4406 cleanliness code [7] followed by the results for representative passes and failures, their respective ISO Cleanliness codes and the corresponding water values, Table 6. All of the data presented in Table 6 was for particle counts obtained from the Parker ACM 20. Several of the evaluations had water contents around the limit of 15–ppm. It appears the pass/fail has an ISO code at 30-µm(c) between 13-14.

Table 7. ISO 4406 Cleanliness Code

Number of particles per millilitre		Scale number
More than	Up to and including	
2 500 000		> 28
1 300 000	2 500 000	28
640 000	1 300 000	27
320 000	640 000	26
160 000	320 000	25
80 000	160 000	24
40 000	80 000	23
20 000	40 000	22
10 000	20 000	21
5 000	10 000	20
2 500	5 000	19
1 300	2 500	18
640	1 300	17
320	640	16
160	320	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2,5	5	9
1,3	2,5	8
0,64	1,3	7
0,32	0,64	6
0,16	0,32	5
0,08	0,16	4
0,04	0,08	3
0,02	0,04	2
0,01	0,02	1
0,00	0,01	0

Table 8. ISO 4406 Cleanliness Codes for the API/IP 1581 5th Edition Evaluations

Fuel	ISO Cleanliness Code at End of Test	Maxmium Water Content, ppm
DoD Elements		
JP-8	No data	5.2
JP-8	17/16/12/9	2.3
JP-8	No data	1.5
JP-8	17/16/14/13	41.8
JP-8+100 (256 ppm)	23/22/18/13	7.5
JP-8+100 (10:1 dilution)	No data	4.7
JP-8+100 (10:1 dilution)	18/17/15/12	5
JP-8+100 (5:1 dilution)	23/23/20/15	37.1
JP-8+100 (5:1 dilution)	23/22/19/17	Off-scale
JP-8+100 (1:1 dilution)	23/23/21/17	Off-scale
EI 1581 5th Edition M Category		
JP-8	21/19/14/11	5.9
JP-8	16/15/11/9	2.5
JP-8+100 (256 ppm)	21/19/14/13	40
JP-8+100 (256 ppm)	20/18/16/14	41.3
JP-8+100 (256 ppm)	21/18/15/13	14.9
JP-8+100 (1:1 dilution	23/22/19/16	Off-scale
JP-8+100 (1:1 dilution	23/22/19/16	42.5
JP-8+100* (1:1 dilution)	22/22/19/14	41.5
JP-8+100 (5:1 dilution)	22/21/19/16	Off-scale
JP-8+100 (5:1 dilution)	21/19/14/11	5.9
JP-8+100 (5:1 dilution)	22/21/17/14	Off-scale
JP-8+100* (5:1 dilution)	20/19/16/12	42.7
JP-8+100 (10:1 dilution)	22/20/17/14	17.7
JP-8+100 (10:1 dilution)	20/18/16/14	65
JP-8+100 (10:1 dilution)	22/21/17/14	42.1
JP-8+100* (10:1 dilution)	18/17/13/11	43.1
JP-8+100* (20:1 dilution)	18/17/13/10	43.0
JP-8+100* (40:1 dilution)	17/16/13/11	43.7

The ISO 4406 cleanliness codes for 4-, 6-,14-, and 30 µm (c) are plotted comparing the three light extinction particle counter sensors, e.g., Parker ACM20, Seta AvCount, and Parker IOS, Figures 1-4. All three sensors were calibrated per ISO 11171 by the manufacturer. These comparisons were determined for the passing evaluation using JP-8 test fuel. The Seta and Parker IOS have good comparative results whereas the Parker ACM20 readings differ by 4-6 ISO codes. However, all sensors rate the cleanliness of the aviation fuel as fuel based on the data in Table 5. Note: The Parker ACM 20 is only calibrated for ISO codes 7 and larger. Any ISO codes below 7 reads zero (0).

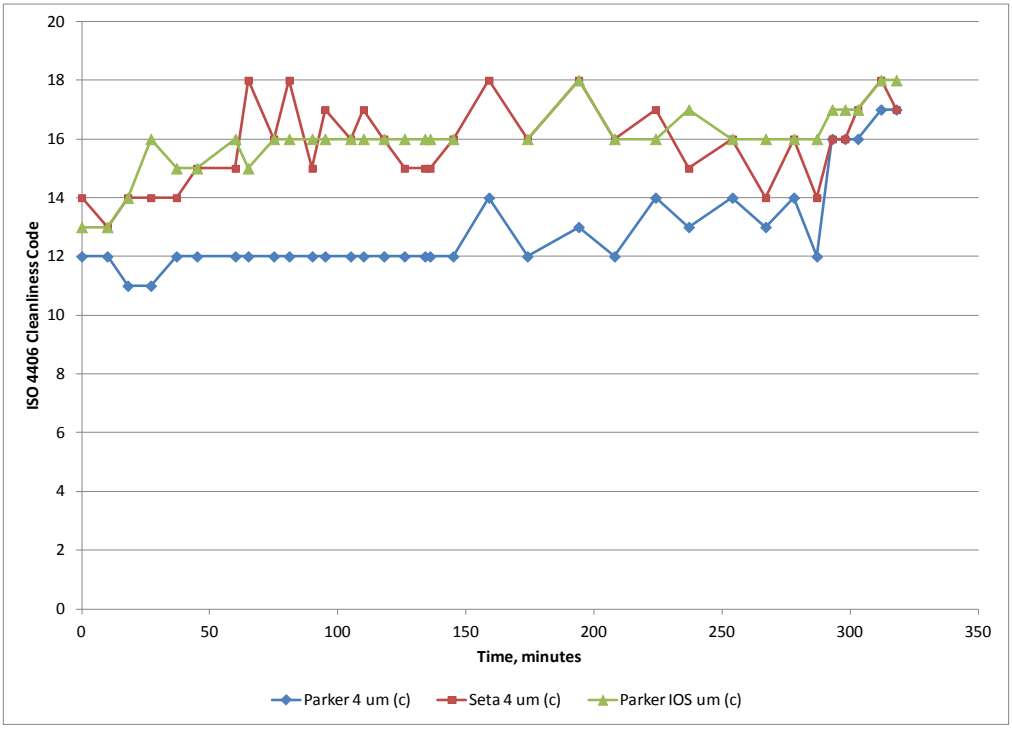

Figure 1. JP-8 Test Fuel – Comparison of Particle Counters at 4 µm (c)

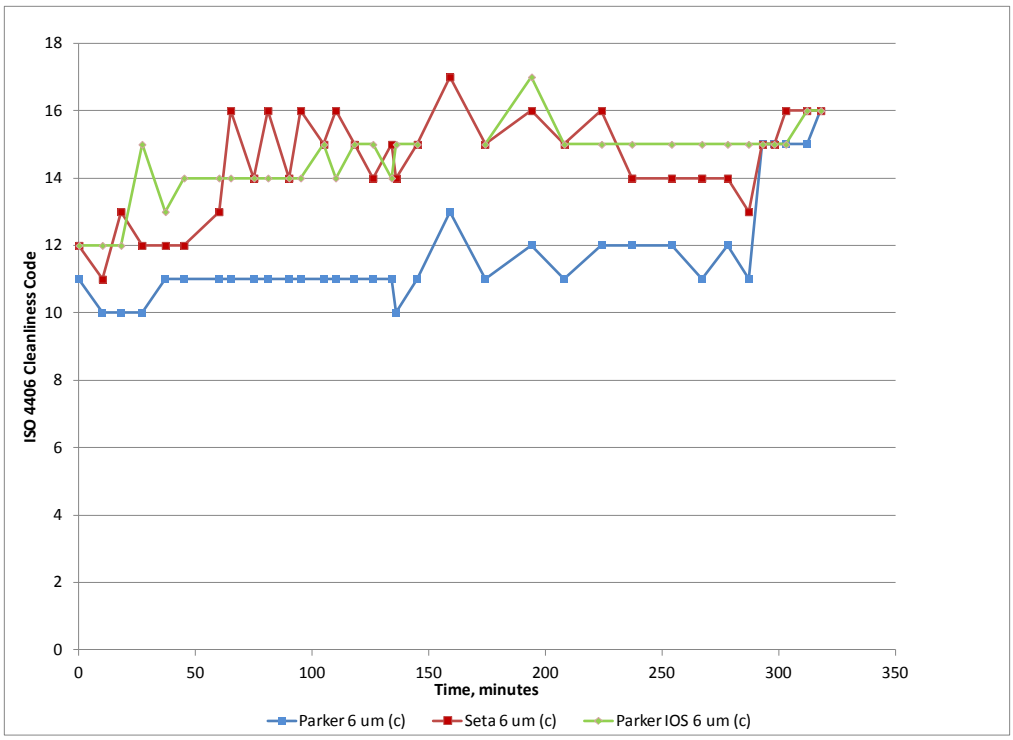

Figure 2. JP-8 Test Fuel – Comparison of Particle Counters at 6 µm (c)

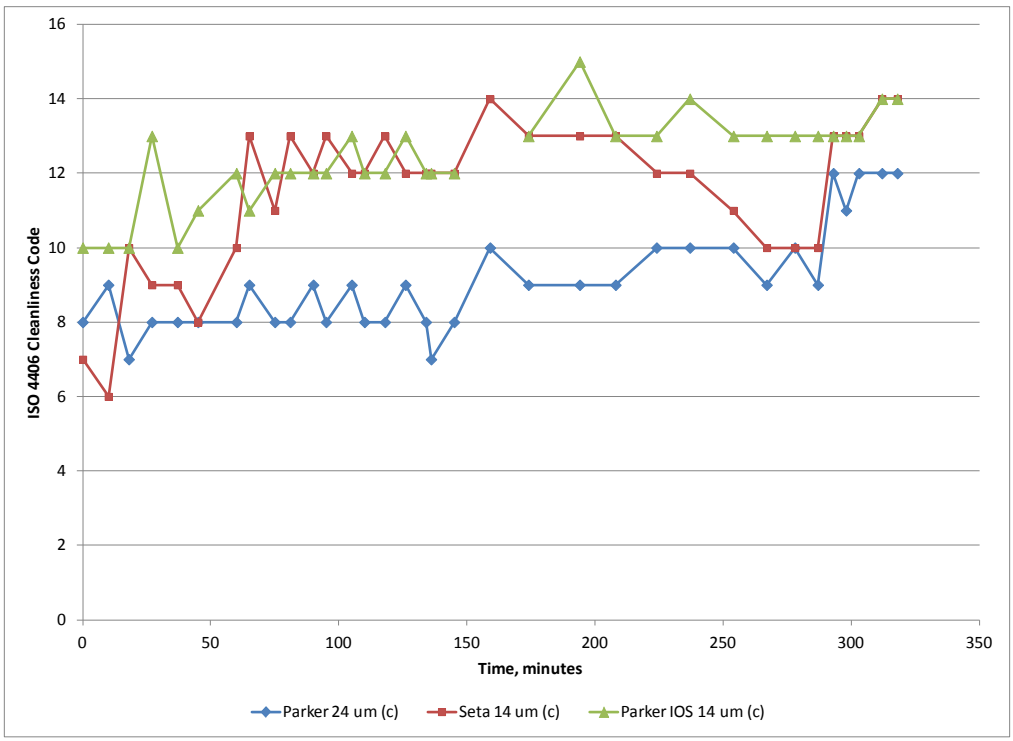

Figure 3. JP-8 Test Fuel – Comparison of Particle Counters at 14 µm (c)

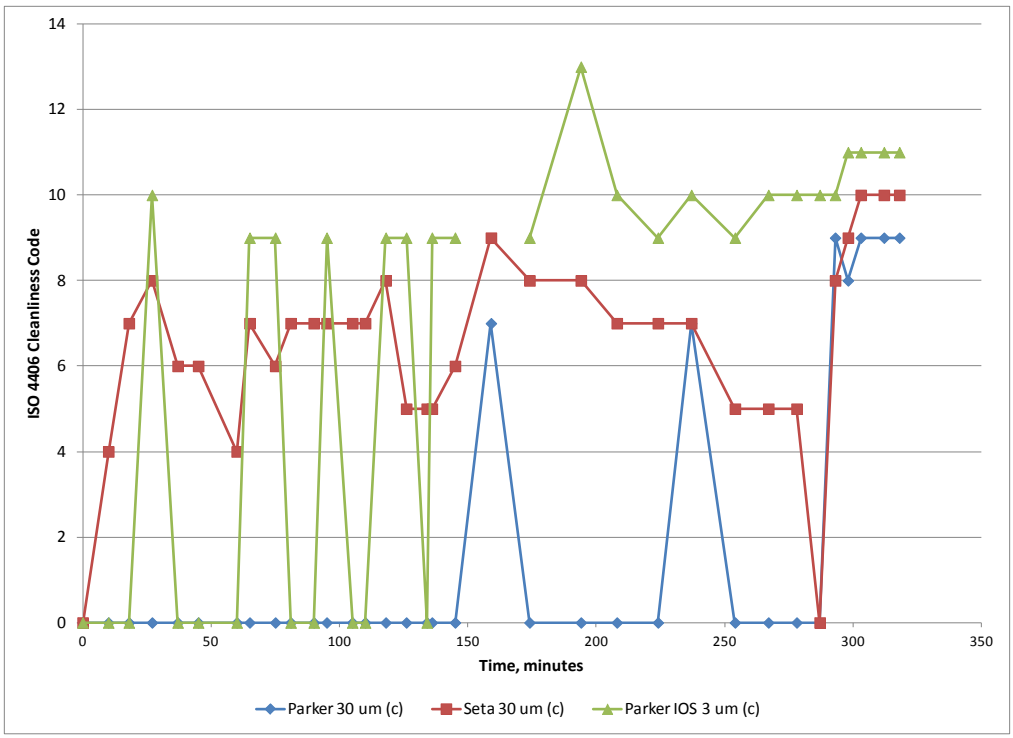

Figure 4. JP-8 Test Fuel – Comparison of Particle Counters at 30 µm (c)

Figures 5-8 present the same particle count data as shown above but for JP-8+100 using the old batch of the +100 additive. The additive concentration was 256-ppm for this evaluation. This evaluation was a marginal pass with the maximum free water content being 14.9 ppm during the 3% water challenge. At 4-um (c), all three sensors readings are very comparable. However, at the larger particle sizes, more separation is seen with the Parker IOS sensor.

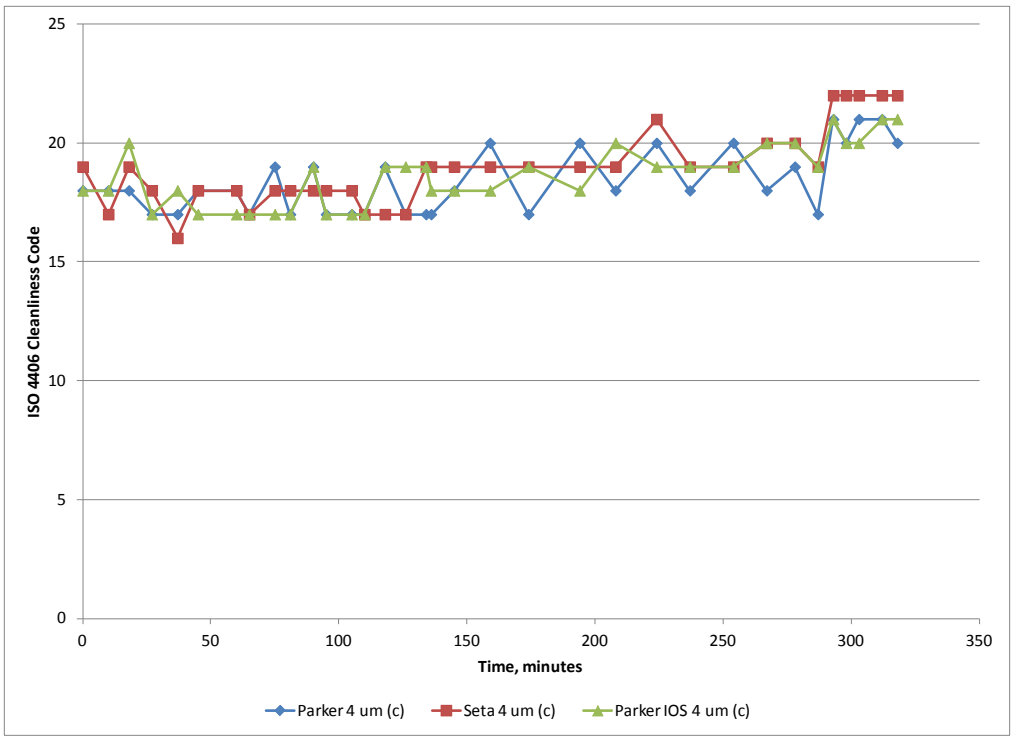

Figure 5. JP-8+100 Test Fuel – Comparison of Particle Counters at 4 µm (c)

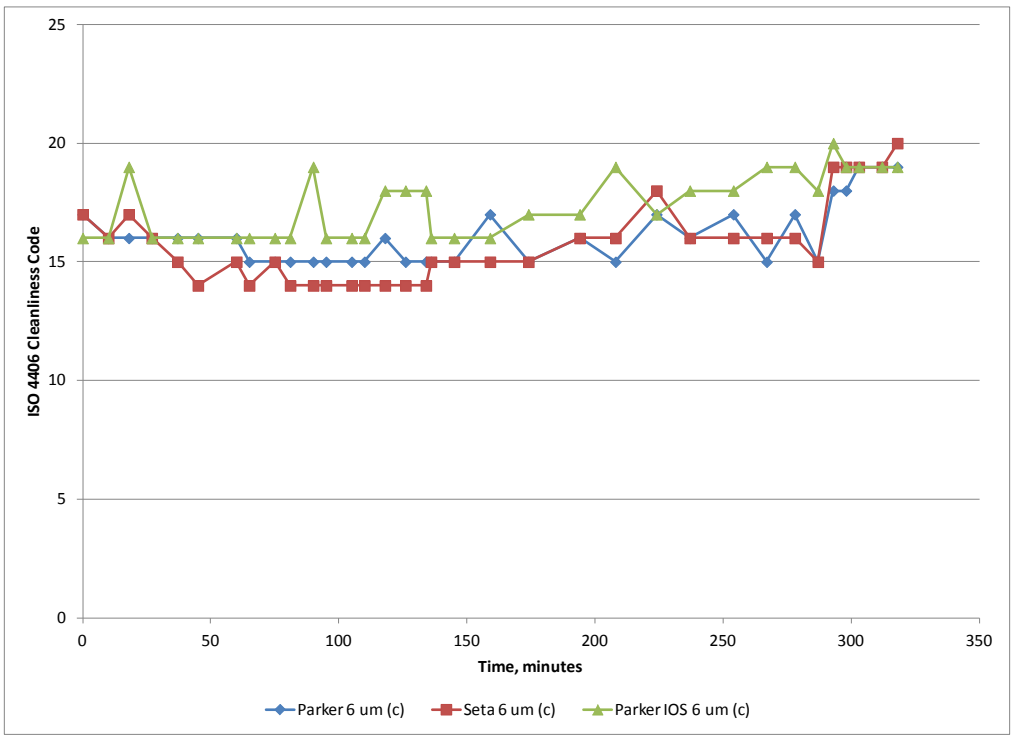

Figure 6. JP-8+100 Test Fuel – Comparison of Particle Counters at 6 µm (c)

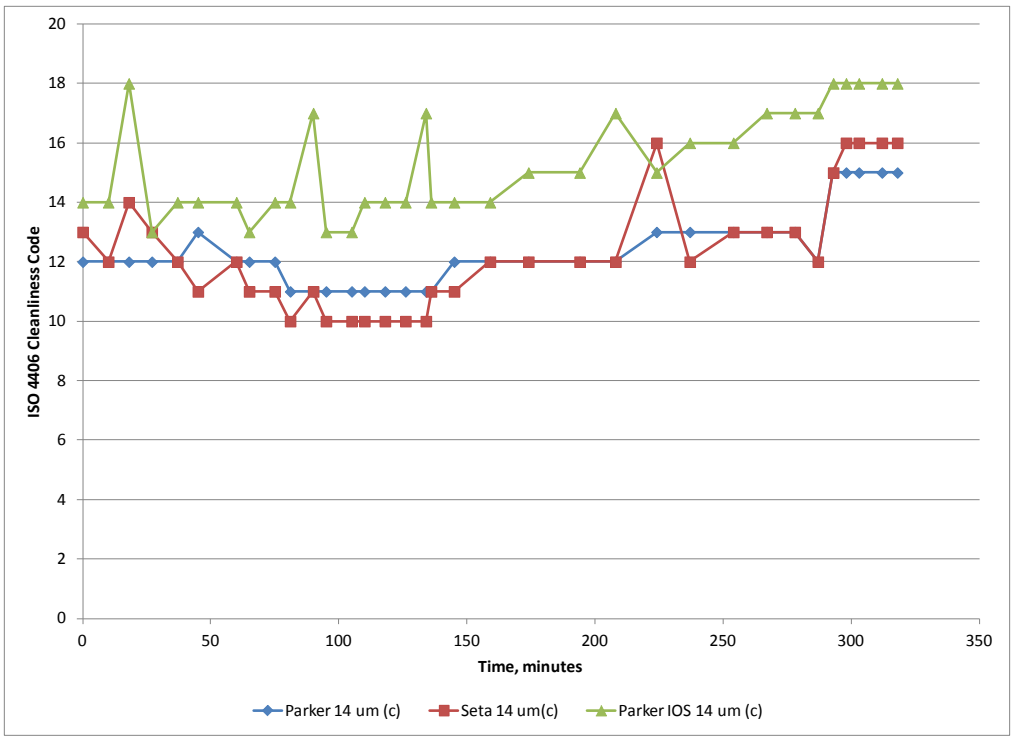

Figure 7. JP-8+100 Test Fuel – Comparison of Particle Counters at 14 µm (c)

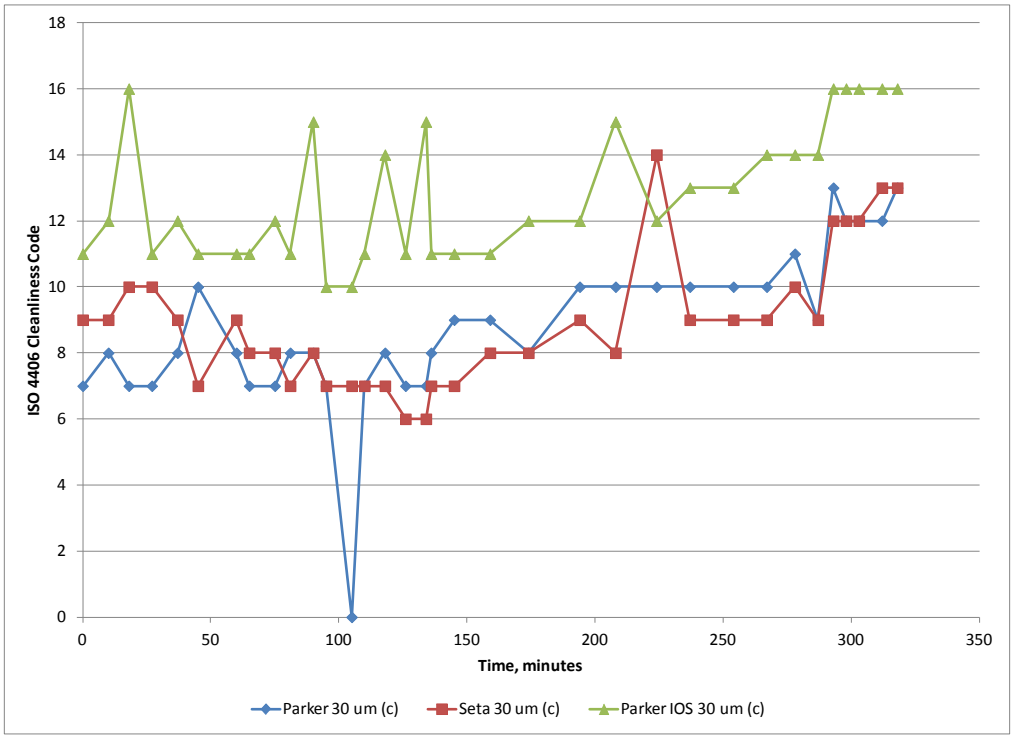

Figure 8. JP-8+100 Test Fuel – Comparison of Particle Counters at 30 µm (c)

Figures 9-12 present the particle count data for the JP-8+100 20:1 dilution evaluation. The Parker IOS unit was not available for this evaluation so only the Parker ACM20 and Seta AvCount results are compared. The 4- and 6-µm (c) data agree very well but the14- and 30- µm (c) data seem to differ. As noted above, for ISO codes below 7, the Parker ACM 20 reads zero (0) and one or two particles at these low ISO codes makes a big difference in the ISO cleanliness code. Therefore, the two sensors results are not significantly different.

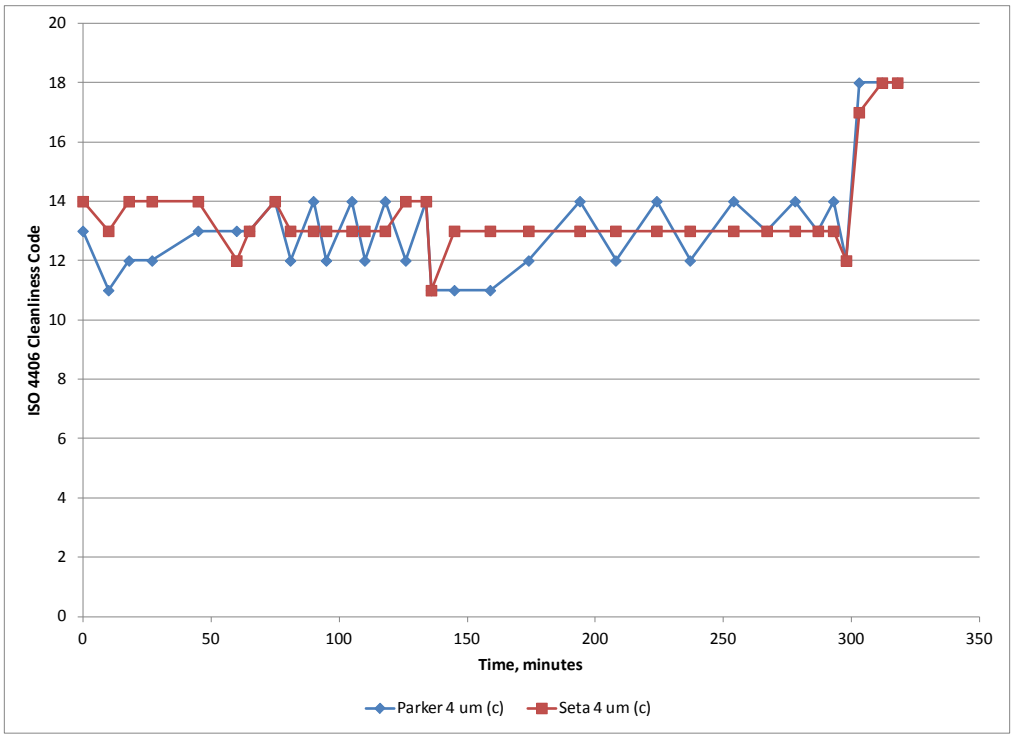

Figure 9. JP-8+100 Test Fuel (20:1 dilution) – Comparison of Particle Counters at 4 µm (c)

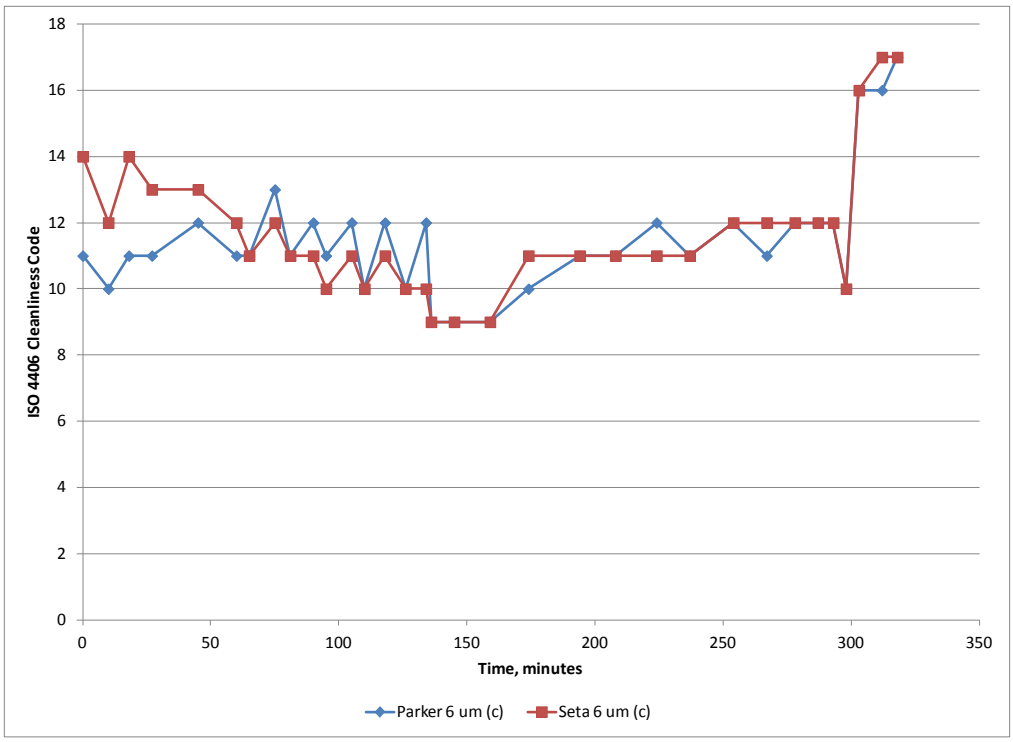

Figure 10. JP-8+100 Test Fuel (20:1 dilution) – Comparison of Particle Counters at 6 µm (c)

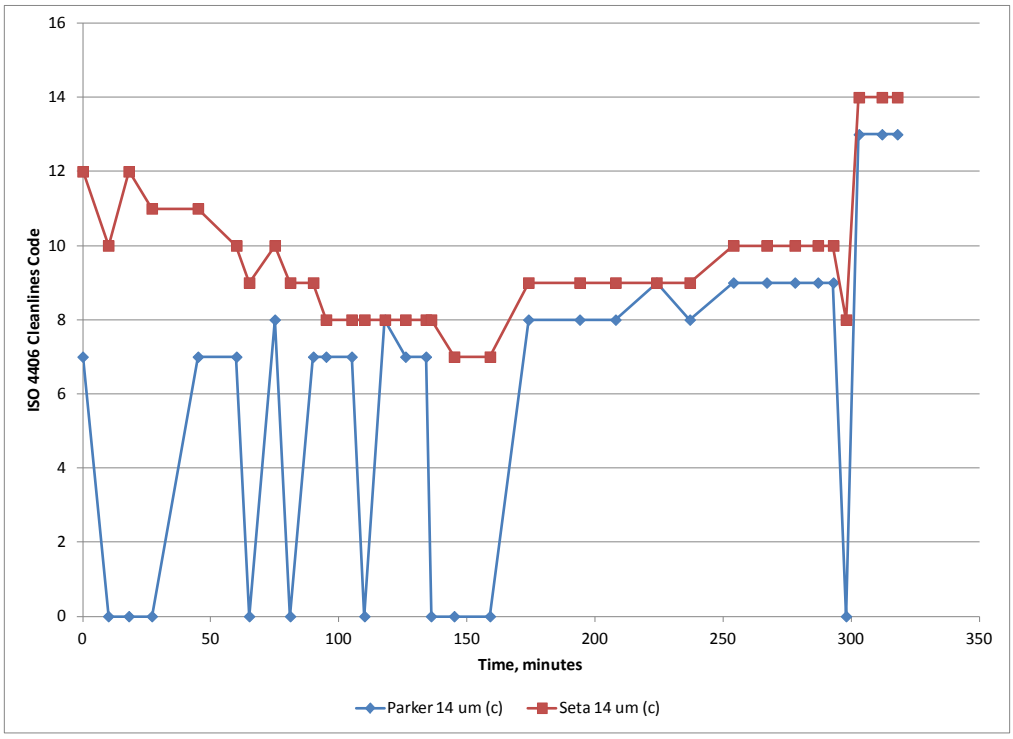

Figure 11. JP-8+100 Test Fuel (20:1 dilution) – Comparison of Particle Counters at 14 µm (c)

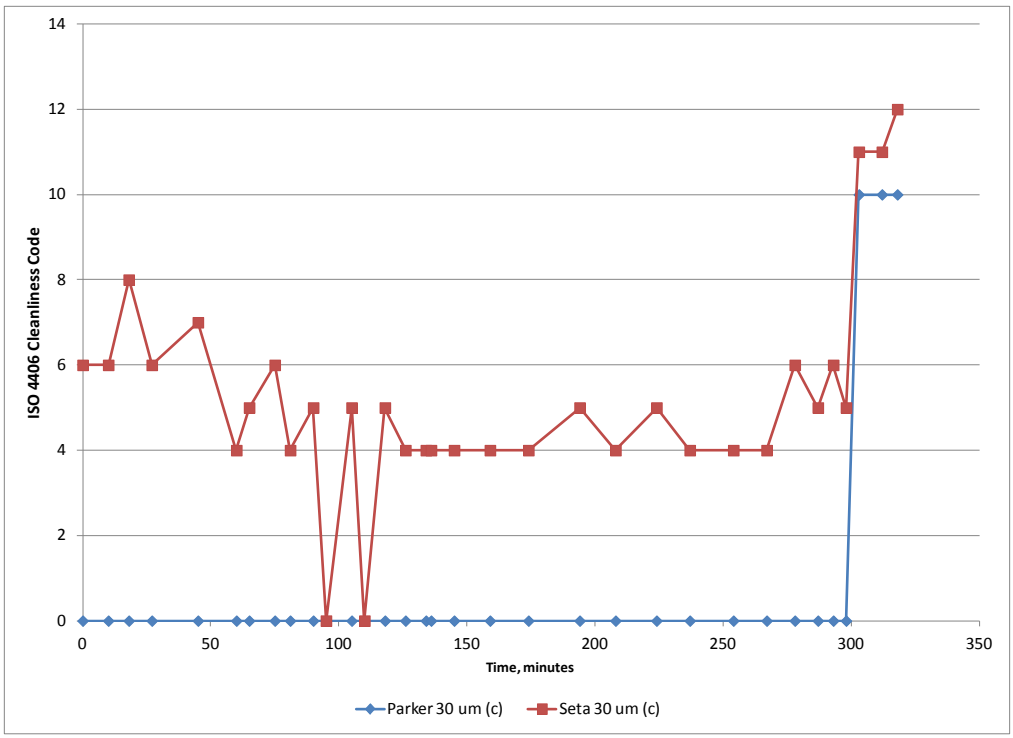

Figure 12. JP-8+100 Test Fuel (20:1 dilution) – Comparison of Particle Counters at 30 µm (c)

It was noted earlier in the report (end of Section 3) that the new batch of +100 additive had a different color, odor and consistency. Comparing Figures 5-8 (JP-8+100 – marginal pass at 14.9 ppm free water) to the respective particle size in Figures 9-12 (JP-8+100 20:1 dilution – severe failure at 43 ppm free water) illustrates a major issue between these results. The JP-8+100 with the 20:1 dilution which fails the EI 1581 5th Edition evaluation has ISO cleanliness codes that are significantly lower than those of the JP-8+100 that had a marginal pass. Table 9 illustrates similar ISO Cleanliness Code discrepancies comparing 5:1 and 10:1 dilutions between the new and old batches of +100 additive.

Table 9. ISO 4406 Cleanliness Code Comparison Between Batches of +100 Additive

Test Fuel	ISO 4406 Cleanliness Codes	Free Water Content, ppm
JP-8	21/19/14/11	5.9
JP-8	16/15/11/9	2.5
JP-8+100 256 ppm – Old Batch	21/18/15/13	14.9
JP-8+100 20:1 dilution – New Batch	17/16/13/11	43.0

Table 10 illustrates similar ISO Cleanliness Code discrepancies comparing 5:1 and 10:1 dilutions between the new and old batches of +100 additive.

Table 10. ISO 4406 Cleanliness Code Comparison Between Batches of +100 Additive at 5:1 and 10:1 Dilution

Test Fuel	ISO 4406 Cleanliness Codes	Free Water Content, ppm
JP-8+100 5:1 dilution (old)	22/21/19/16	Off-scale
JP-8+100 5:1 dilution (old)	21/19/14/11	5.9
JP-8+100 5:1 dilution (new)	20/19/16/12	42.7
JP-8+100 10:1 dilution (old)	20/18/16/14	65
JP-8+100 10:1 dilution (old)	22/20/17/14	17.7
JP-8+100 10:1 dilution (new)	18/17/13/11	42.1

Utilizing the other electronic sensors to confirm the perceived difference in results, it can be seen in Figure 13 that the Sigrist and Optek turbidity results detect a response during the 20:1 dilution evaluation. Comparing this response to previous failures illustrates this response is the same as previous failure modes, Figure 13. Figure 14 shows a failure with JP-8+100 with the DoD element at a 5:1 dilution with the free water content off-scale.

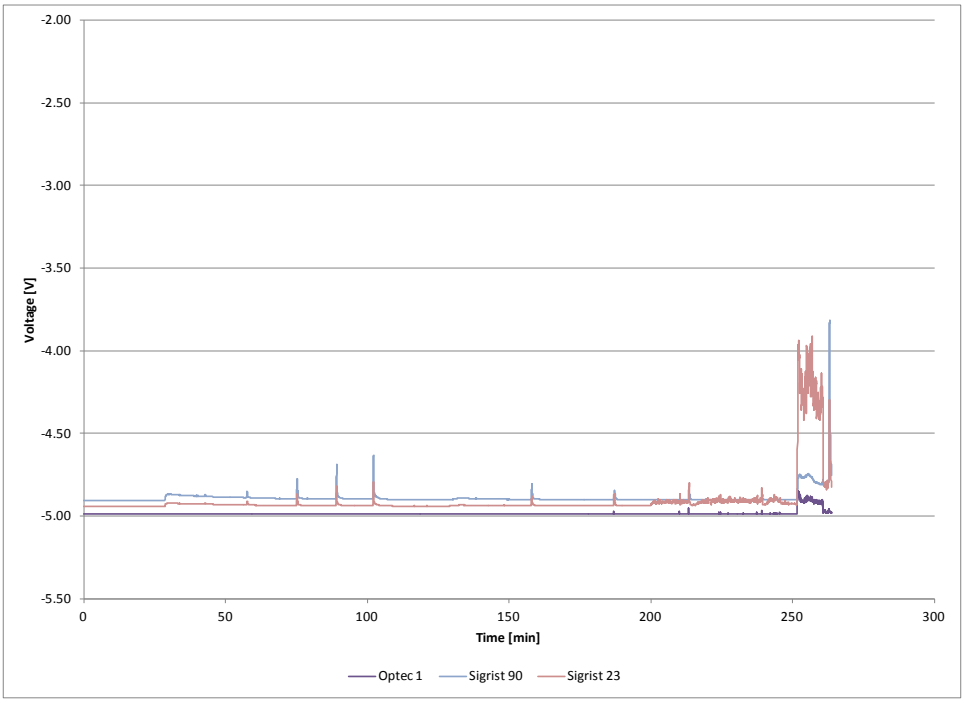

Figure 13. JP-8+100 Test Fuel (20:1 dilution) – Comparison of Sigrist and Optek Turbidity Results

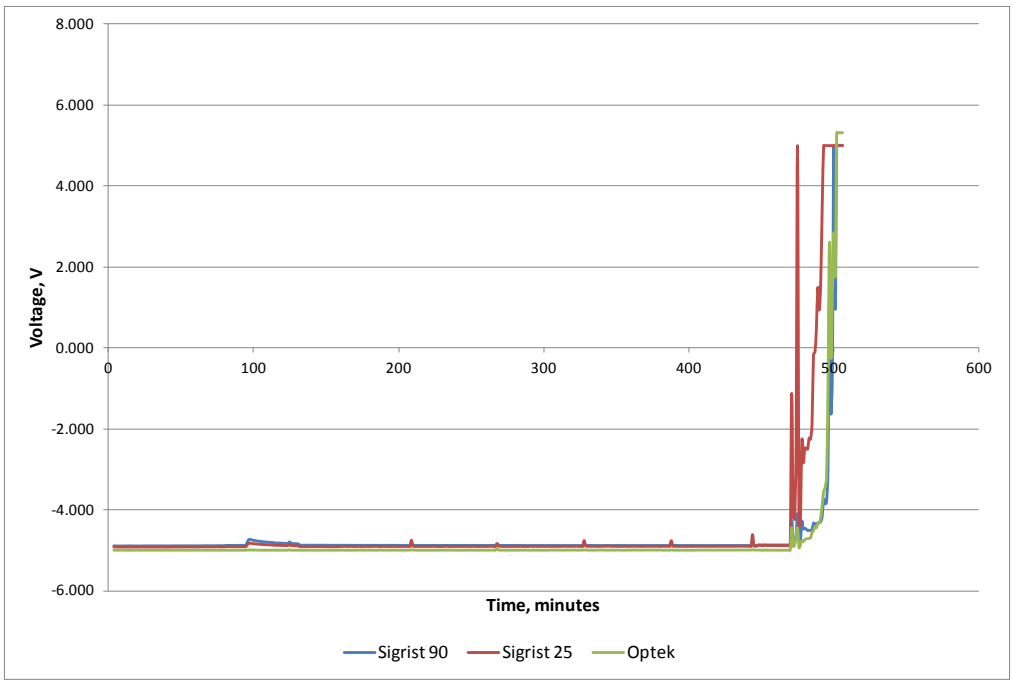

Figure 14. JP-8+100 Test Fuel– Comparison of Sigrist and Optek Turbidity Results

6.0 CONCLUSIONS

Multiple evaluations were performed using DoD and API/IP 1581 5th Edition M category test filters to determine the proper dilution ratio for blend back defueling operations to avoid deleterious effects on performance of military filtration equipment. In addition to the JP-8+100 research, particle counters were used to recommend ISO 4406 cleanliness levels that meet the EI 1581 5th Edition limits of 0.26 mg/L solids and 15-ppm free water.

The EI 1581 5th Edition test method was modified to better simulate real-world operating conditions by only challenging the test filter with solids until the test element reaches approximately half of its service life or 7 psid.

Based upon the data for both the DoD and API/IP 1581 5th Edition M category evaluations, the dilution ratio for cleanup of the JP-8+100 fuel remains undefined as the test results are non-conclusive. Filtration performance was sporadic for both the DoD and EI 1581 5th Edition M category filtration systems when filtering the +100 at the recommended dosage (256-ppm). Both

the DoD and EI 1581 5th Edition M category filtration systems performed properly at 100-ppm water challenges but consistently failed the 3% water challenge. For the EI 1581 5th Edition M category tests, these failures were for both sets of tests – tests thought to have poor knife edge sealing of the separator, and the repeat tests that had the proper separator knife edge sealing.

ISO 4406 cleanliness codes were determined for all evaluations and a fourth term was added to the code to include 30-µm(c) to assist with determination of excessive water. Traditionally, most recommendations for ISO 4406 are suggesting in the order of 19/15/12 for the three digit normal ISO 4406 code. Based on the data generated in this study, it is recommended to propose a 19/17/14/13 ISO 4406 Cleanliness Code for the JP-8 specification.

Test data suggests there was a difference in the chemistry between the two batches of the GE SPEC-AID 8Q462 +100 additive. It is recommended that further research be performed with this new batch of +100 additive to see what is present in the chemistry that reduces the readability of the contamination by light extinction particle counters but is detected by other electronic sensors.

7.0 REFERENCES

[1] Southwest Research Institute Aviation Fuel Filtration Cooperative R&D Program, SwRI Project No. 08.10844, prepared by Bessee, G.B., Buckingham, J.P., and Hughes, V.H., February 2006

[2] ASTM D3948 – Standard Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer

[3] ASTM D1655 – Standard Specification for Aviation Turbine Fuels

[4] EI 1581 – Specifications and Qualification Procedures for Aviation Jet Fuel Filter/Separators

[5] EI 1581 Specifications and Qualification Procedures for Aviation Jet Fuel Filter/Separators - 4th Edition

[6] "Effects of Various Corrosion Inhibitors/Lubricity Improvers (CI/LI) on Fuel Filtration Performance," Bessee, G.B., TFLRF Interim Report No. 394, Contract No. DAAK-07-99-C-L053, March 2008

[7] ISO 4406 – Hydrualic Fluid Power – Fluids – Method for coding the level of contamination by solids particles, second edition 1999.

APPENDIX A
EI 1581 DATA SHEETS

5th Edition Single Element Data Sheet													
Test Specification: API/IP 1581 5th Edition			SET:								Date: 6/13/11		
Test No. 1 JP-8			Full-Scale:										
Vessel: DOD		Filter/Coalescer: Velcon			Separator: Velcon						Type: -S -S-LD		
Additive Addition		Model: I-420MM			Model: SI-522						Manufacturing Date:		
Category:		M-100			M				C				
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	10,000	A	256			D	1	37.9	420	I	1,0		
Ending		B	0,15%			B	0,15%	15 gal		II	15		
		C	15			C	15	568 g					
Used		D	2,0										
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				95	0				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	20	2.7	298/238								85
Water 0,01%	5	0	20	2.7	311/247		<1/0.1						
	10	5	20	2.9		7.6	1.5/0.4						
	15	10 s/s	20.2	3.4		7.6	2/0.8						
	25	20 s/s	20	3.9		7.6	2.5/1.0						
	35	30 s/s	20	4.1	301/495	7.6	2.5/1.2						86

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	19.9	3.9	309/550								86
	50	15	20	3.2				19	2		0	4L	86
		15 s/s	20.2	3.5				19	3		0.075	4L	
	65	30	20.1	5.1	305/293			19	4		0.05	4L	
		30 s/s	20.2	5.4				19	5		0.125	4L	
	80	39	20.2	7.2				19	6		0.025	4L	87
		45 s/s						19	7			4L	
	85	50											
	95	60						19	8			4L	
		60 s/s						19	9			4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0,01%	110	0	20.2	7	305/302		1/0.1						87
	112	2	20	8.1		7.6	2/0.4						
	115	5	20	8.3		7.6	2/0.5						
	125	15	20.2	9.1		7.6	2.5/1.1						
		30 s/s	20.3	9.9	308/505	7.6	3/1.5						88
	155	45	20.1	9.9		7.6	2/1.7						
	170	60 s/s	20.6	10.2	304/539	7.6	3/1.9						
	185	75	20	10.3		7.6	2.5/1.5						
		90 s/s	20.3	10.5		7.6	3/1.8						89
	215	105	20	10.6	310/590	7.6	3.5/1.8						
		120 s/s	20.2	10.8		7.6	4/2.3						
	245	135	20.2	11.1		7.6	4/2.2						
		150 s/s	20.2	10.9		7.6	3/2.2						
Water Coalescence Test - 3%	260	0	20.8	8	303/608		4/2.5						
	262	2	20.5	15.8		2.27 lpm	3/1.9						90
	265	5	19.8	16.6		2.27 lpm	3/1.7						
		10 s/s	20.4	20.1	303/558	2.27 lpm	3/5.2						
		20 s/s	20.3	24.1		2.27 lpm	4/2.6						
	290	30	20.2	28.8	312/579	2.27 lpm	3.5/2.3						90

JP-8 with DoD Elements

Test Specification: API/IP 1581 5th Edition				SET:								Date: 6/13/11			
256 ppm				Full-Scale:											
Vessel: DoD		Filter/Coalescer: Velcon				Separator: Velcon						Type: -S -S-LD			
Additive Addition		Model: I-420MM				Model: SI-522						Manufacturing Date:			
Category:		M-100				M				C					
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)		
Beginning	10,000	A	256	9,691 g	463	D	1,0			I	1,0				
Ending		B	0,15%	15 gal		B	0,15%			II	15				
		C	15	568 g		C	15								
Used		D	1	37.85											
Mixing Time: 30 minutes							MSEP	Before	After						
Element Conditioning:		in-Situ		External				97	0						
Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F		
Start-up	0	0	20	3.2	393/295								81		
Water 0,01%	5	0	20	3.2	395/398		1/0.7								
	10	5	20	3.6		7.6	1.5/0.6								
	15	10 s/s	20	4		7.6	1.5/0.7								
	25	20 s/s	19.9	4.5		7.6	1.5/0.4								
	35	30 s/s	19.9	4.9	400/403	7.6	1.5/1.0						83		
Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F		
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	20	5	408/410								83		
	50	15	19.7	5.7				19	2		0.05	4L	84		
		15 s/s	20.2	6.1				19	3		0.225	4L			
	65	30	20.1	6.3	407/420			19	4		0.1	4L			
		30 s/s	20.4	6.9				19	5		0.15	4L			
	80	35	20.2	7.3				19	6		0.15	4L			
		45 s/s						19	7			4L			
	85	50													
	95	60						19	8			4L			
		60 s/s						19	9			4L			
	110	75						19	10			4L			
		75 s/s						19	11			4L			
Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F		
Water Coalescence Test - 0.01%	110	0	20.4	6.6	410/417		1.5/0.6						84		
	112	2	20.2	7.1		7.6	1.5/0.6								
	115	4	20	7.3		7.6	1.5/0.7								
	125	15	19.7	10.4		7.6	1.5/1								
		30 s/s	19.7	11.7	415/419	7.6	1.5/1.1						84		
	155	45	20.1	12.6		7.6	1.5/1.2								
	170	60 s/s	20.4	12.9	406/415	7.6	2/1.8								
	185	75	20.2	13.3		7.6	1.5/1.3								
		90 s/s	20.4	13.4		7.6	2.5/2.3						86		
	215	105	19.9	13.9	408/423	7.6	1.5/1.4								
		120 s/s	20.2	13.4		7.6	2/1.7								
	245	135	20	14		7.6	2/1.7								
		150 s/s	20.5	13.9		7.6	2.5/2.1								
Water Coalescence Test - 3%	260	0	20.6	11.1	423/408		1.5/1.7								
	262	2	19.9	22.2		2.27	2/1.9						88		
	265	5	20.2	26.5		2.27	2/1.6								
		10 s/s	20.6	33	404/508	2.27	2.5/2.3								
		20 s/s	20.2	44.9		2.27	4.5/4.4								
	290	30	20	56.7	510/521	2.27	9/7.5						88		

JP-8+100 (256-ppm) with DoD Elements

Test Specification: API/IP 1581 5th Edition				SET:								Date: 7/30/11			
10:1				Full-Scale:											
Vessel:			Filter/Coalescer: Velcon			Separator: Velcon						Type: -S -S-LD			
Additive Addition			Model: I-420MM			Model: SI-522						Manufacturing Date:			
Category:		M-100				M				C					
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)		
Beginning	14,000	A	25.6	1356.5 g		D	1,0			I	1,0				
Ending		B	0,15%	21 gal		B	0,15%			II	15				
		C	15	203.4		C	15								
Used		D	1,0	13.55											
Mixing Time: 30 minutes							MSEP	Before	After						
Element Conditioning:		in-Situ		External				96	0						
Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F		
Start-up	0	0	20.2	2.7	504/379								83		
Water 0,01%	5	0	20.2	2.8	512/393		<1/0.3								
	10	5	20.2	3.1		7.56	<1/0.3								
	15	10 s/s	20.1	3.2		7.56	<1/0.5								
	25	20 s/s	20	3.9		7.56	<1/0.9								
	35	30 s/s	20.4	4.4	495/469	7.56	<1/1.2						86		
Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F		
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	20.2	4.1	501/470								86		
	50	15	20.2	5.1				19	2		0.05	4L	87		
		15 s/s	20.2	5.9				19	3		0.025	4L			
	65	24	20	7.1	494/475			19	4		0.01	4L			
		30 s/s						19	5			4L			
	80	45						19	6			4L			
		45 s/s						19	7			4L			
	85	50													
	95	60						19	8			4L			
		60 s/s						19	9			4L			
	110	75						19	10			4L			
		75 s/s						19	11			4L			
Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F		
Water Coalescence Test - 0.01%	110	0	20	6.1			1/0.6						87		
	112	2	20	7.2		7.56	1/0.5								
	115	4	20.2	8.1		7.56	1/0.5								
	125	15	20	9.1		7.56	2/1.1								
		30 s/s	20	9.8		7.56	2/1.5						87		
	155	45	20	9.9		7.56	2/1.2								
	170	60 s/s	20.4	10.3		7.56	3/1.9								
	185	75	20	10.9		7.56	3/1.7								
		90 s/s	20	11.1		7.56	3/2.0						88		
	215	105	20	11.3		7.56	2/1.8								
		120 s/s	20	11.3		7.56	3/2.3								
	245	135	20	11.8		7.56	2/1.9								
		150 s/s	20.1	11.8		7.56	3.5/2.6								
Water Coalescence Test - 3%	260	0	20.4	8		0	2/1.7								
	262	2	20.2	18.3		2.27 lpm	8/6.7						89		
	265	5	20.4	21.2		2.27 lpm	2.5/2.1								
		10 s/s	19.8	26.9		2.27 lpm	4.5/3.3								
		20 s/s	20.2	33.2		2.27 lpm	4.5/3.5								
	290	30	19.9	37.1		2.27 lpm	6.5/4.7						89		

JP-8+100 (10:1 Dilution) with DoD Elements

Test Specification: API/IP 1581 5th Edition				SET:							Date: 7/11/11		
#3				Full-Scale:									
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon					Type: -S -S-LD		
Additive Addition		Model: I-420MM				Model: SI-522					Manufacturing Date:		
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	13,780	A	25.6	2,670 g		D	2,0			I	1,0		
Ending		B	0,15%	21 gal		B	0,15%			II	15		
		C	15	782.4 g		C	15						
Used		D	1,0	52.15 g									
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				99	0				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	20	2.7	504/396								83
Water 0,01%	5	0	20	2.7	505/412		1/0						
	10	5	19.9	2.9		7.56	2.5/1.5						
	15	10 s/s	19.9	3.1		7.56	3/2.1						
	25	20 s/s	20	3.6		7.56	3/2.5						
	35	30 s/s	20	3.9	497/472	7.56	3.5/2.8						85
Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	20.1	3.8	501/480								85
	50	15	20	3.6				19	2		0.125	4L	86
		15 s/s	20.2	3.7				19	3		0	4L	
	65	24	20	4.3	501/475			19	4		0.1	4L	
		30 s/s	20	5.4				19	5		0	4L	
	80	47	20	7				19	6			4L	
		45 s/s						19	7			4L	
	85	50											
	95	60						19	8			4L	
		60 s/s						19	9			4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	
Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	20	7.1	502/484		1/0.4						86
	112	2	20	7.7		7.56	1.5/0.5						
	115	4	19.8	8.1		7.56	3/1.9						
	125	15	20	9.3		7.56	1.5/1.2						
		30 s/s	20.2	9.9	483/484	7.56	4.5/3.3						87
	155	45	20.2	10.8		7.56	4.5/3.7						
	170	60 s/s	20	11.1	501/503	7.56	2/1.4						
	185	75	19.9	12.1		7.56	2/1.5						
		90 s/s	20.6	12.6		7.56	4.5/3.6						88
	215	105	20.2	13.1	494/503	7.56	5/4						
		120 s/s	20.4	13.1		7.56	5.5/4.7						
	245	135	20.2	13.8		7.56	5/4.2						
		150 s/s	20.6	14.1		7.56	2/2						
Water Coalescence Test - 3%	260	0	20.1	7.7	506/520	0	2/1.6						
	262	2	20.4	22.2		2.27 lpm	2/1.5						89
	265	5	20.4	27.5		2.27 lpm	2/1.5						
		10 s/s	20.6	37.8	503/713	2.27 lpm	2.5/2						
		20 s/s	19.7	62.2		2.27 lpm	---/16.6						
	290	30	19.8	73	494/699	2.27 lpm	---/37.1						89

JP-8+100 (5:1 Dilution) with DoD Elements

Test Specification: API/IP 1581 5th Edition				SET:							Date: 7/22/11		
#3				Full-Scale:									
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon					Type: -S -S-LD		
Additive Addition		Model: I-420MM				Model: SI-522					Manufacturing Date:		
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	10,000	A	25.6	1,938 g		D	2,0			I	1,0		
Ending		B	0,15%	15 gal		B	0,15%			II	15		
		C	15	568 g		C	15						
Used		D	1,0	37.85 g									
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				97	0				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	20	3.2	371/246								80
Water 0,01%	5	0	20	3.2	308/316		<1/0.5						
	10	5	20	3.8		7.56	<1/0.5						
	15	10 s/s	20	4.2		7.56	<1/0.5						
	25	20 s/s	20.2	4.7		7.56	1/0.8						
	35	30 s/s	20.2	5.2	335/349	7.56	2/1.1						82

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	20	5.1	380/361								82
	50	15	20	6.6				19	2		0.075	4L	82
		15 s/s	20.2	6.9				19	3		0.05	4L	
	65	24	20.2	7.1	388/370			19	4		0.025	4L	
		30 s/s						19	5			4L	
	80	47						19	6			4L	
		45 s/s						19	7			4L	
	85	50											
	95	60						19	8			4L	
		60 s/s						19	9			4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	20	6.7	386/368		1/0.5						82
	112	2	20	7.1		7.56	1/0.8						
	115	4	20	8.1		7.56	2/0.7						
	125	15	20.1	7.3		7.56	1/0.8						
		30 s/s	20.2	7.8	378/372	7.56	2/1.4						82
	155	45	20.1	8.4		7.56	1.5/1						
	170	60 s/s	20.6	8.9	368/378	7.56	2/1.5						
	185	75	20.1	9.3		7.56	2/1.1						
		90 s/s	20.2	9.9		7.56	2/1.5						83
	215	105	19.9	10.1	371/379	7.56	2/1.2						
		120 s/s	20.2	10.4		7.56	5/4.2						
	245	135	19.9	11.1		7.56	1.5/1.1						
		150 s/s	20.6	11.4		7.56	6/4.8						
Water Coalescence Test - 3%	260	0	20.1	10.4	370/384	0	3.5/3.2						
	262	2	20.3	10.3		2.27 lpm	/14.4						84
	265	5	20.2	23.6		2.27 lpm	/12.2						
		10 s/s	20.4	45.4	383/360	2.27 lpm	/20.3						
		20 s/s	20.8	67.1		2.27 lpm	off scale						
	290	30	20.1	71.6	395/385	2.27 lpm	off scale						84

JP-8+100 (5:1 Dilution) – Re-run – with DoD Elements

Test Specification: API/IP 1581 5th Edition				SET:							Date: 7/28/11		
#3				Full-Scale:									
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon					Type: -S -S-LD		
Additive Addition		Model: I-420MM				Model: SI-522					Manufacturing Date:		
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	10,083	A	25.6	4,845 g		D	2,0			I	1,0		
Ending		B	0,15%	15 gal		B	0,15%			II	15		
		C	15	568 g		C	15						
Used		D	2,0	37.9 g									
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				97	0				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	20.4	3.1	366/355								82
Water 0,01%	5	0	20.4	3.1	371/363		4/3.5						
	10	5	20.2	3.4		7.56	2/1.6						
	15	10 s/s	20.1	3.8		7.56	3/2.3						
	25	20 s/s	20.2	4.3		7.56	3.5/2.8						
	35	30 s/s	20.2	4.8	367/375	7.56	2/1.3						84

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	20.2	4.6	368/389								84
	50	15	20.3	4.6				19	2		0	4L	85
		15 s/s	20.4	3.9				19	3		0	4L	
	65	30	20.4	6.6	371/385			19	4		0.05	4L	
		28	20.2	7.3				19	5		0.025	4L	
	80	47						19	6			4L	
		45 s/s						19	7			4L	
	85	50											
	95	60						19	8			4L	
		60 s/s						19	9			4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	20.2	8.1	386/368		1.5/0.8						82
	112	2	20.1	8.3		7.56	1.5/0.9						
	115	4	20.4	8.5		7.56	3/1.8						
	125	15	20.4	9.6		7.56	1.5/1						
		30 s/s	20.3	10.5	378/372	7.56	2/1.1						82
	155	45	20.4	11.5		7.56	2/1.4						
	170	60 s/s	20.2	11.8	368/378	7.56	2/1.3						
	185	75	20.2	12.4		7.56	2.5/1.6						
		90 s/s	20.2	12.5		7.56	1.5/1.1						83
	215	105	20.4	13.3	371/379	7.56	2.5/1.6						
		120 s/s	20.3	13.3		7.56	2/1.5						
	245	135	20.4	13.6		7.56	2.5/2.1						
		150 s/s	20.2	13.7		7.56	2/1.4						
Water Coalescence Test - 3%	260	0	20.4	10.4	370/384	0	4.5/2.7						
	262	2	20.4	28		2.27 lpm	--/9.1						84
	265	5	20.4	38.7		2.27 lpm	--/41.3						
		10 s/s	20.5	53.7	383/360	2.27 lpm	--/137.7						
		20 s/s	20	75.2		2.27 lpm	off scale						
	290	30				2.27 lpm							

JP-8+100 (1:1 Dilution) with DoD Elements

Test Specification: API/IP 1581 5th Edition			SET:								Date: 8/4/11		
#3			Full-Scale:										
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon					Type: -S -S-LD		
Additive Addition		Model: I614MM TB				Model: SO-606V5					Manufacturing Date:		
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	12,430	A	25.6			D	1,0	47 g		I	1,0		
Ending		B	0,15%			B	0,15%	18.6 gal		II	15		
		C	15			C	15	706 g					
Used		D	2,0										
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				98	0				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	30	1.8	558/358								84
Water 0,01%	5	0	30	1.7	531/391		0.5/0.1						
	10	5	29.9	1.8		11.4	1.5/0.5						
	15	10 s/s	30.4	1.9		11.4	1.5/0.6						
	25	20 s/s	30.3	2.1		11.4	1.5/0.7						
	35	30 s/s	30	2.3	529/501	11.4	2/1.3						86

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	30	2.3	531/511								86
	50	15	30	2.2				19	2		0	4L	86
		15 s/s	30.3	2.2				19	3		0.025	4L	
	65	30	30	2.7	569/536			19	4		0.075	4L	
		28	30	2.8				19	5		0.05	4L	
	80	47	29.9	3.1				19	6		0.1	4L	
		45 s/s	30	3.6				19	7		0	4L	
	85	50	30.7	5.5									
	95	60	30.3	6.6	566/543			19	8		0.025	4L	87
		60 s/s	29.8	7.1				19	9		0	4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	30.3	7.4	539/509		0.5/0						82
	112	2	30.1	7.2		11.4	1/0						
	115	4	30.2	7.4		11.4	1.5/0.4						
	125	15	30.2	7.9		11.4	1.5/1.2						
		30 s/s	30.2	7.2	556/528	11.4	2/1.4						88
	155	45	30	7.3		11.4	2.5/1.5						
	170	60 s/s	30.4	6.9	562/575	11.4	2/1.4						
	185	75	30.2	7.1		11.4	2.5/1.4						
		90 s/s	30.4	6.8		11.4	2.5/1.6						91
	215	105	30.2	6.9	---/591	11.4	2.5/1.7						
		120 s/s	30.4	6.9		11.4	2.5/1.8						
	245	135	29.9	7.1		11.4	2.5/1.7						
		150 s/s	30	7.2		11.4	2.5/1.9						
Water Coalescence Test - 3%	260	0	30.3	5.8	---/604	0	2.5/1.5						
	262	2	30.3	15		3.41 lpm	1.5/1						92
	265	5	30.3	18.2		3.41 lpm	3/1.9						
		10 s/s	30	21.8	---/588	3.41 lpm	3.5/2.4						
		20 s/s	30.2	30.8		3.41 lpm	4/2.7						
	290	30	30.2	39.8	---/652	3.41 lpm	9/5.9						92

JP-8 with EI 1581 5th Edition M Category Elements

Test Specification: API/IP 1581 5th Edition				SET:							Date: 8/12/11		
#3				Full-Scale:									
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon					Type: -S -S-LD		
Additive Addition		Model: I614MM TB				Model: SO-606V5					Manufacturing Date:		
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	12,430	A	25.6	12,104 g		D	2,0			I	1,0		
Ending		B	0,15%	18.6 gal		B	0,15%			II	15		
		C	15	706 g		C	15						
Used		D	1,0	47.3 g									
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				97	0				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	30.2	2.4	568/544								83
Water 0,01%	5	0	30.1	2.4	564/550		1.5/0.8						
	10	5	30	2.7		11.4	2/0.6						
	15	10 s/s	30.1	3.1		11.4	2/0.8						
	25	20 s/s	30.1	3.6		11.4	2/1						
	35	30 s/s	29.8	3.8	570/555	11.4	2/0.9						83

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	29.8	3.8	582/552								83
	50	15	30	4.5				19	2			4L	84
		15 s/s	30.2	4.6				19	3			4L	
	65	30	30	5.7	570/556			19	4			4L	
		28	30	6.1				19	5			4L	
	80	47	30	7.1				19	6			4L	
		45 s/s						19	7			4L	
	85	50											
	95	60						19	8			4L	
		60 s/s						19	9			4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	29.9	6.9	571/560	11.4	1.5/0.7						84
	112	2	30.1	6.9		11.4	2/0.9						
	115	4	30.1	7		11.4	2/0.9						
	125	15	30	7.2		11.4	2/0.9						
		30 s/s	30.1	7.4	574/559	11.4	2.5/1.2						84
	155	45	29.9	8		11.4	2.5/1.1						
	170	60 s/s	29.9	8.2	568/541	11.4	2.5/1.2						
	185	75	29.8	8.7		11.4	2/0.9						
		90 s/s	30.2	9		11.4	2.5/1.6						86
	215	105	29.9	9.5	562/558	11.4	2/1						
		120 s/s	29.9	9.6		11.4	3/1.6						
	245	135	30	9.9		11.4	2/1						
		150 s/s	30	10.1		11.4	3.5/2						
Water Coalescence Test - 3%	260	0	30	9.7	573/562	0	2/1.1						
	262	2	30.3	12.4		3.41 lpm	>12/10.6						88
	265	5	30.1	14.7		3.41 lpm	--/5.1						
		10 s/s	30.4	17.9	570/617	3.41 lpm	3.5/2.4						
		20 s/s	30	23.3		3.41 lpm	4.5/3.3						
	290	30	30.2	26	570/604	3.41 lpm	>12/40						89

JP-8+100 (256-ppm) with EI 1581 5th Edition M Category Elements

Test Specification: API/IP 1581 5th Edition				SET:							Date: 8/25/11		
#3				Full-Scale:									
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon					Type: -S -S-LD		
Additive Addition		Model: I614MM TB				Model: SO-606V5					Manufacturing Date:		
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	15,200	A	25.6	1134 g		D	2,0			I	1,0		
Ending		B	0,15%	22.8 gal		B	0,15%			II	15		
		C	15	863 g		C	15						
Used		D	1,0	58 g									
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				96	0				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	30.3	2.1	605./478								82
Water 0,01%	5	0	30.2	2.1	603/482		1.2/0.4						
	10	5	30.3	2.3		11.4	1.5/0.5						
	15	10 s/s	30.4	2.5		11.4	1.5/0.5						
	25	20 s/s	30.3	3.1		11.4	2/0.8						
	35	30 s/s	30.2	3.2	571/535	11.4	2/0.8						82
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	30	3	573/537								82
	50	15	30.1	3.8				19	2		0	4L	83
		15 s/s	30.4	3.9				19	3		0.05	4L	
	65	30	30.2	4.2	584/550			19	4		0.05	4L	
		28	30.4	4.4				19	5		0.075	4L	
	80	47	29.9	5.1				19	6		0.1	4L	
		45 s/s	30.2	5.5				19	7		0.125	4L	
	85	50	30	5.7							0.075		
	95	60	30.1	6.9	580/554			19	8		0.75	4L	84
		60 s/s	30.3	7				19	9		0.125	4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	
Water Coalescence Test - 0.01%	110	0	30	6.6	577/551	11.4	1.5/0.6						84
	112	2	30.1	7.4		11.4	1.5/0.7						
	115	4	30	8.5		11.4	2/0.7						
	125	15	29.8	10.4		11.4	2/1.1						
		30 s/s	30.3	11.2	587/556	11.4	2/1						84
	155	45	30.1	12.1		11.4	2/1						
	170	60 s/s	30.4	12.6	585/570	11.4	2/1.1						
	185	75	30.1	13.4		11.4	2/1						
		90 s/s	30.4	13.7		11.4	2/1.1						86
	215	105	29.9	14.5	586/575	11.4	2.5/1.4						
		120 s/s	30.2	14.8		11.4	2.5/1.5						
	245	135	30	15.3		11.4	2.5/1.4						
		150 s/s	30.7	15.4		11.4	2.5/1.6						
Water Coalescence Test - 3%	260	0	30.3	8.7	575/534	0	2/1.2						
	262	2	30.1	20		3.41 lpm	---/10						88
	265	5	30.3	24.7		3.41 lpm	---17.9						
		10 s/s	30.3	28.2	---/466	3.41 lpm	---/9.2						
		20 s/s	30.2	37.5		3.41 lpm	---15.7						
	290	30	30.1	43.7	---/403	3.41 lpm	---17.7						89

JP-8+100 (10:1 Dilution) with EI 1581 5th Edition M Category Elements

Test Specification: API/IP 1581 5th Edition			SET:						Date: 9/2/11				
#3			Full-Scale:										
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon			Type: -S -S-LD				
Additive Addition		Model: I614MM TB				Model: SO-606V5			Manufacturing Date:				
Category:		M-100				M			C				
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	12,053	A	25.6	1,205 g		D	2,0			I	1,0		
Ending		B	0,15%	18.6 gal		B	0,15%			II	15		
		C	15	706 g		C	15						
Used		D	1,0	47 g									
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				92	0				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	30.2	1.7	622/474								85
Water 0,01%	5	0	30.2	1.7	628/489		1/0.2						
	10	5	30.1	2.1		11.4	1/0.2						
	15	10 s/s	30.3	2.4		11.4	2/0.6						
	25	20 s/s	30.2	2.6		11.4	2/0.7						
	35	30 s/s	30.1	2.8	632/572	11.4	2/0.8						83

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solid's Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	29.9	2.7	627/588								83
	50	15	29.9	3.2				19	2		0	4L	83
		15 s/s	30.1	3.4				19	3		0	4L	
	65	30	30	4.5	682/599			19	4		0.125	4L	
		28	30	4.6				19	5		0.075	4L	
	80	45	29.8	4.8				19	6		0.075	4L	
		45 s/s						19	7			4L	
	85	50											
	95	60						19	8			4L	
		60 s/s						19	9			4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	29.9	7.5	627/607	11.4	1/0.2						84
	112	2	29.9	8.5		11.4	2/0.4						
	115	4	30	8.9		11.4	2/0.5						
	125	15	30.1	9.8		11.4	2/0.8						
		30 s/s	30.4	9.9	643/598	11.4	2/1						84
	155	45	29.9	10.7		11.4	2/1						
	170	60 s/s	30.3	10.9	712/608	11.4	2/1.5						
	185	75	29.9	11.6		11.4	2/1.2						
		90 s/s	30.4	11.8		11.4	2.5/1.7						86
	215	105	29.9	12.5	757/643	11.4	2/1.2						
		120 s/s	30.3	12.7		11.4	2/1.5						
	245	135	30	13.1		11.4	2/1.3						
		150 s/s	30.3	13.3		11.4	2/1.4						
Water Coalescence Test - 3%	260	0	30	7.9	666/655	0	1.5/1						
	262	2	30.2	18.9		3.41 lpm	---/34.5						88
	265	5	30.4	29.6		3.41 lpm	---/40.7						
		10 s/s	30.1	34.7	662/740	3.41 lpm	---/12						
		20 s/s	30	49.8		3.41 lpm	---/65						
	290	30	30.1	58.2	670/756	3.41 lpm	off						89

JP-8+100 (10:1 Dilution) Re-run with EI 1581 5th Edition M Category Elements

Test Specification: API/IP 1581 5th Edition			SET:						Date: 9/15/11				
#3			Full-Scale:										
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon			Type: -S -S-LD				
Additive Addition		Model: I614A4 TB				Model: SO-606V5			Manufacturing Date:				
Category:		M-100				M			C				
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	12,480	A	25.6	12,094 g		D	2,0			I	1,0		
Ending		B	0,15%	18.7 gal		B	0,15%			II	15		
		C	15	708.6 g		C	15						
Used		D	1,0	47.2 g									
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				94	0				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	30.3	2.7	485/476								79
Water 0,01%	5	0	30.2	2.7	490/481		3/2.7						
	10	5	30.1	3.2		11.4	1.5/0.5						
	15	10 s/s	30.1	3.3		11.4	1.5/0.5						
	25	20 s/s	30	3.6		11.4	2/0.7						
	35	30 s/s	30	3.9	496/512	11.4	2/0.5						80

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	29.9	3.7	507/523								81
	50	15	30	3.4				19	2		0	4L	81
		15 s/s	29.9	3.7				19	3		0.025	4L	
	65	30	29.9	5.1	504/510			19	4		0.05	4L	
		28	30	5.6				19	5		0.025	4L	
	80	45	30	7				19	6		0.01	4L	
		45 s/s						19	7			4L	
	85	50											
	95	60						19	8			4L	
		60 s/s						19	9			4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	30	7	509/506	11.4	1/0						82
	112	2	29.9	7.9		11.4	1.5/0.3						
	115	4	30.1	8.7		11.4	1.5/0.6						
	125	15	30.3	12.2		11.4	2/0.9						
		30 s/s	30.3	14.3	513/522	11.4	2/0.8						82
	155	45	30	15.5		11.4	1.5/0.9						
	170	60 s/s	30.4	15.9	517/541	11.4	2/0.9						
	185	75	30.4	17.1		11.4	2/1.1						
		90 s/s	30.3	17.1		11.4	2/1.2						83
	215	105	29.9	17.5	521/543	11.4	1.5/1.1						
		120 s/s	30.4	17.7		11.4	2/1.6						
	245	135	29.9	18.5		11.4	1.5/1.3						
		150 s/s	30.2	18.3		11.4	2/1.6						
Water Coalescence Test - 3%	260	0	30.1	16.5	515/552	0	1.5/1.2						
	262	2	30.3	27.5		3.41 lpm	9.5/6.8						85
	265	5	29.9	36.5		3.41 lpm	9/7.6						
		10 s/s	30.4	45	521/626	3.41 lpm	5/4.3						
		20 s/s	29.9	55.2		3.41 lpm	---/41.4						
	290	30	30.3	63.5		3.41 lpm	---/41.3						86

JP-8+100 (256-ppm) with EI 1581 5th Edition A4 Category Elements

Test Specification: API/IP 1581 5th Edition			SET:						Date: 9/29/11				
#3			Full-Scale:										
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon			Type: -S -S-LD				
Additive Addition		Model: I614MM TB				Model: SO-606V5			Manufacturing Date:				
Category:		M-100				M			C				
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	12,260	A	25.6	2,376 g		D	2,0			I	1,0		
Ending		B	0,15%	18.4 gal		B	0,15%			II	15		
		C	15	696.1 g		C	15						
Used		D	1,0	46.4 g									
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				95	0				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	29.8	2.2	548/383								79
Water 0,01%	5	0	30	2.2	503/440		0.5/0.3						
	10	5	29.9	2.5		11.4	2/0.4						
	15	10 s/s	30.1	2.8		11.4	1.5/0.4						
	25	20 s/s	30	3.3		11.4	2/0.5						
	35	30 s/s	30.2	3.6	550/525	11.4	2/0.6						81

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22.5 psid)	35	0	30.3	3.4	556/557								81
	50	15	30.1	29				19	2		0.125	4L	81
		15 s/s	30.2	2.8				19	3		0.3	4L	
	65	30	30.3	26	551/544			19	4		0.225	4L	
		28	30.2	2.9				19	5		0.1	4L	
	80	45	30.2	3.6				19	6		0	4L	
		45 s/s	30	4.3				19	7		0.2	4L	
	85	50	30	5.2									
	95	60	29.9	6.5	583/564			19	8		0.025	4L	83
		60 s/s	30.4	7.1				19	9		0.125	4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	30	6.8	555/565	11.4	1/0						82
	112	2	29.8	7.9		11.4	1/0						
	115	4	29.9	8.6		11.4	1.5/0.3						
	125	15	29.9	10.1		11.4	1.5/0.7						
		30 s/s	30.1	11	566/575	11.4	2/1.1						82
	155	45	29.9	12.1		11.4	2/0.8						
	170	60 s/s	30.2	12.6	567/599	11.4	1.5/0.8						
	185	75	29.9	13.6		11.4	2/1.1						
		90 s/s	29.9	13.9		11.4	2/1.1						83
	215	105	30.2	15.2	576/613	11.4	2/1.2						
		120 s/s	30.3	15.3		11.4	2/1.6						
	245	135	30.3	16.5		11.4	2/1.1						
		150 s/s	30.2	17		11.4	2.5/1.8						
Water Coalescence Test - 3%	260	0	29.9	8.4	573/618	0	2/1.1						
	262	2	30.3	28.6		3.41 lpm	5.5/2.9						85
	265	5	30.2	31.8		3.41 lpm	4.5/3.3						
		10 s/s	29.9	48.8	580/747	3.41 lpm	---/12.7						
		20 s/s	29.8	60.3		3.41 lpm	off scale						
	290	30				3.41 lpm							

JP-8+100 (5:1 Dilution) with EI 1581 5th Edition M Category Elements

Test Specification: API/IP 1581 5th Edition			SET:						Date:10/19/11			
#3			Full-Scale:									
Vessel:		Filter/Coalescer: Velcon			Separator: Velcon				Type: -S -S-LD			
Additive Addition		Model: I614MM TB			Model: SO-606V5				Manufacturing Date:			
Category:		M-100			M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	12,440	A	25.6	1205 g		D	2,0			I	1,0		
Ending		B	0,15%	19 gal		B	0,15%			II	15		
		C	15	706 g		C	15						
Used		D	1,0	47 g									
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				95	0				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	30.2	2	234/193								65
Water 0,01%	5	0	30	2	247/202		1/0.3						
	10	5	29.9	2.3		11.4	1/0.1						
	15	10 s/s	30.3	2.5		11.4	1/0.1						
	25	20 s/s	30.3	2.8		11.4	1.5/0.2						
	35	30 s/s	30	3	398/320	11.4	1/0.2						70

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	29.9	2.7	396/344								70
	50	15	30	3.3				19	2		0.05	4L	71
		15 s/s	30	3.3				19	3		0	4L	
	65	30	29.8	3.5	399/371			19	4		0	4L	
		28	29.9	3.9				19	5		0	4L	
	80	45	29.9	4.5				19	6		0	4L	
		45 s/s	29.8	5.8				19	7		0	4L	
	85	50	29.9	5.9									
	95	60	30.1	6.7	403/376			19	8		0	4L	71
		60 s/s	30	7				19	9		0	4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	29.9	7.2	401/372	11.4	<1/0.2						82
	112	2	29.9	8.1		11.4	<1/0.2						
	115	4	30	8.4		11.4	7/0.3						
	125	15	30.1	9		11.4	1/0.3						
		30 s/s	30	9	405/372	11.4	1/0.4						82
	155	45	29.9	10.2		11.4	1/0.4						
	170	60 s/s	30.4	10.2	398/395	11.4	1.5/0.3						
	185	75	30	10.8		11.4	1.5/0.4						
		90 s/s	30.4	11.1		11.4	1.5/0.5						83
	215	105	30	12.1	415/394	11.4	1.5/0.5						
		120 s/s	30.4	13.1		11.4	1.5/0.5						
	245	135	30.3	12.8		11.4	1.5/0.5						
		150 s/s	30.4	11.3		11.4	1.5/0.5						
Water Coalescence Test - 3%	260	0	30.3	20	417/398	0	1.5/0.4						
	262	2	30.3	24.9		3.41 lpm	>12/42.1						85
	265	5	29.8	31.8		3.41 lpm	>12/42.1						
		10 s/s				3.41 lpm							
		20 s/s				3.41 lpm							
	290	30				3.41 lpm							

JP-8+100 (10:1 Dilution) Re-run with 1581 5th Edition M Category Elements

Test Specification: API/IP 1581 5th Edition			SET:						Date:10/27/11				
15			Full-Scale:										
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon			Type: -S -S-LD				
Additive Addition		Model: I614MM TB				Model: SO-606V5			Manufacturing Date:				
Category:		M-100				M			C				
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	12,500	A	25.6			D	1,0	47.3 g		I	1,0		
Ending		B	0,15%			B	0,15%	18.75 gal		II	15		
		C	15			C	15	709.8 g					
Used		D	2,0										
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				98	50				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	30.3	2.5	522/222								76
Water 0,01%	5	0	30.3	2.5	516/242		1/0.2						
	10	5	30.3	2.8		11.4	1.5/0.4						
	15	10 s/s	30.4	3.2		11.4	1.5/03						
	25	20 s/s	30.3	3.4		11.4	2/0.4						
	35	30 s/s	30.3	3.6	518/324	11.4	2/0.5						76

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	30	3.6	525/380								76
	50	15	30	4.6				19	2		0.1	4L	76
		15 s/s	30.4	6.3				19	3		0.075	4L	
	65	30	30.2	7.6	529/396			19	4		0	4L	
		28						19	5			4L	
	80	45						19	6			4L	
		45 s/s						19	7			4L	
	85	50											
	95	60						19	8			4L	
		60 s/s						19	9			4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	30.1	8.3	542/432	11.4	1.5/0.6						76
	112	2	30	8.4		11.4	2/0.6						
	115	4	30	8.5		11.4	1.5/0.6						
	125	15	29.9	8.7		11.4	1.5/0.6						
		30 s/s	30.4	9	544/450	11.4	1.5/0.5						76
	155	45	29.9	9.5		11.4	1.5/0.6						
	170	60 s/s	30.3	9.6	520/482	11.4	1.5/0.5						
	185	75	30	10.1		11.4	1.5/0.5						
		90 s/s	30.3	10.4		11.4	1.5/0.5						77
	215	105	30.1	10.8	551/496	11.4	1.5/0.5						
		120 s/s	30.3	11.1		11.4	1.5/0.7						
	245	135	29.9	11.7		11.4	1.5/0.7						
		150 s/s	30.4	11.7		11.4	1.5/0.6						
Water Coalescence Test - 3%	260	0	30.1	11.1	558/516	0	1.5/0.7						
	262	2	30.4	15		3.41 lpm	1.5/0.7						79
	265	5	30.2	16.6		3.41 lpm	1.5/0.7						
		10 s/s	30.1	18	597/554	3.41 lpm	1/0.8						
		20 s/s	30.3	21.3		3.41 lpm	>12/12.8						
	290	30	30.3	26.3	587/580	3.41 lpm	---/41.8						80

JP-8 with EI 1581 5th Edition M Category Elements

Test Specification: API/IP 1581 5th Edition			SET:						Date:11/15/11			
15			Full-Scale:									
Vessel:		Filter/Coalescer: Velcon			Separator: Velcon				Type: -S -S-LD			
Additive Addition		Model: I614MM TB			Model: SO-606V5				Manufacturing Date:			
Category:		M-100			M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	12,300	A	25.6	11,918 g		D	2,0			I	1,0		
Ending		B	0,15%	18.5 gal		B	0,15%			II	15		
		C	15	698 g		C	15						
Used		D	1,0	46.5 g									
Mixing Time: 30 minutes							MSEP	Before	After				
Element Conditioning:		in-Situ		External				98	0				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	29.8	2.4	383/418								69
Water 0,01%	5	0	30.3	2.4	414/411		1/0.1						
	10	5	30.3	2.7		11.4	1.5/0.1						
	15	10 s/s	30.3	3.1		11.4	1.5/0.2						
	25	20 s/s	30.3	3.4		11.4	2/0.3						
	35	30 s/s	30.2	3.6	404/426	11.4	2/0.3						69

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	30.3	3.5	418/434								69
	50	15	30	3.7				19	2		0.075	4L	69
		15 s/s	30.3	4.3				19	3		0.025	4L	
	65	30	30	4.5	418/443			19	4		0	4L	
		28	30.1	5.3				19	5		0.05	4L	
	80	45	30	5.5				19	6		0	4L	
		45 s/s	30.2	6.5				19	7		0.025	4L	
	85	50	30.1	7.1									69
	95	60						19	8			4L	
		60 s/s						19	9			4L	
	110	75						19	10			4L	
		75 s/s						19	11			4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	30.1	7.2	418/439	11.4	1/0.3						69
	112	2	29.9	8		11.4	1/0.3						
	115	4	29.9	8.9		11.4	1.5/0.3						
	125	15	29.9	11		11.4	1.5/0.3						
		30 s/s	30.4	13.1	424/413	11.4	1/0.5						70
	155	45	30.4	14.4		11.4	1/0.5						
	170	60 s/s	30.5	15.1	432/450	11.4	1/0.5						
	185	75	30	16.5		11.4	1.5/0.4						
		90 s/s	30	15.7		11.4	1.50.5						71
	215	105	30.3	17.6	419/433	11.4	1.5/0.5						
		120 s/s	30.2	17.8		11.4	1.5/0.5						
	245	135	30.1	19.4		11.4	1.5/0.5						
		150 s/s	30.3	19.4		11.4	1.5/0.6						
Water Coalescence Test - 3%	260	0	30.3	16.7	418/434	0	1.5/0.5						
	262	2	30.3	29.5		3.41 lpm	--/42.5						72
	265	5	30.2	41.1		3.41 lpm	---/42.5						
		10 s/s	30.3	49.2	422/532	3.41 lpm	---/42.5						
		20 s/s				3.41 lpm							
	290	30				3.41 lpm							

JP-8+100 (1:1 Dilution) Re-run with EI 1581 5th Edition M Category Elements

Test Specification: API/IP 1581 5th Edition			SET:								Date: 5/4/2015		
			Full-Scale:										
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon					Type: -S		
Additive Addition		1-614MMTB				SO-606V5					Manufacturing Date:		
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	15,000	A	25.6			D	2,0	114 g	780	I	1,0		
Ending		B	0,15%			B	0,15%	85 L	735	II	15		
		C	15			C	15	852 g	932				
Used		D	1,0										
Mixing Time: 50 min							MSEP	Before	After				
Element Conditioning:		in-Situ		External				99	39				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	30.1	2.0	753-954								80
Water 0,01%	5	0	30.1	2.1	790-950		1.4						
	10	5	30.3	2.3	820-904	11	1.1						
	15	10 s/s	30.2	2.5	824-916	11	1.1						
	25	20 s/s	30.3	3.2	823-923	11	1.1						
	35	30 s/s	30.0	3.4	881-952	11	1.4						80

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	30	3.4	905-955								80
	50	15	30	3.9				18.9	18		0.040	5L	80
		15 s/s	30.3	3.9				18.9	19		0.060	5L	
	65	26	30.1	4.3	932-966			18.9	20		0.040	5L	
		28	30.3	4.4				18.9	21		0.020	5L	
	80	45	30.1	4.8				18.9	22		0.040	5L	
		45 s/s	30.4	5.1				18.9	23		0.000	5L	
	85	50	30.2	5.2									
	95	60	30.1	5.9	954-978			18.9	24		0.020	5L	80
		60 s/s	30.3	6.1				18.9	25		0.040	5L	
	110	75	30	7				18.9					
		75 s/s											

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	30.2	6.9	972-960	0	1.90						81
	112	2	30.0	7.6		11.4	1.20						
	115	4	30.0	8.2		11.4	1.30						
	125	15	30.1	8.4		11.4	1.50						
		30 s/s	30.3	8.4	984-987	11.4	1.80						81
	155	45	30.0	8.9		11.4	1.40						
	170	60 s/s	30.7	9	993-983	11.4	1.50						
	185	75	30.0	9.3		11.4	1.60						
		90 s/s	30.4	9.3		11.4	2.40						81
	215	105	30.0	9.6	1001-985	11.4	1.50						
		120 s/s	30.4	9.6		11.4	1.70						
	245	135	30.0	9.8		11.4	1.80						
		150 s/s	30.3	9.8		11.4	2.00						
Water Coalescence Test - 3%	260	0	30.2	8.1	1006-1019		2.10						
	262	2	30.2	13.4		3.4 L/m	1.70						82
	265	5	30.2	14.2		3.4 L/m	0.80						
		10 s/s	30.4	14.8	1019-960	3.4 L/m	0.80						
		20 s/s	30.0	16.1		3.4 L/m	0.80						
	290	30	29.8	17.3	1016-940	3.4 L/m	0.70						82

JP-8 with EI 1581 5th Edition M Category Elements

Test Specification: API/IP 1581 5th Edition				SET:							Date: 5/19/2015		
				Full-Scale:									
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon					Type: -S		
Additive Addition		1-614MMTB				SO-606V5					Manufacturing Date:		
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	13,000	A	25.6	12,598 g		D	2,0			I	1,0		
Ending		B	0,15%	74 L		B	0,15%			II	15		
		C	15	738 g		C	15						
Used		D	1,0	98 g									
Mixing Time: 45 min							MSEP	Before	After				
Element Conditioning:		in-Situ		External				99	64				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	29.9	2.0	1223-1160								84
Water 0,01%	5	0	29.8	2	1217-1181	0	1.4						
	10	5	29.8	2.3		11.4	1.2						
	15	10 s/s	30.2	2.7		11.4	1.5						
	25	20 s/s	29.9	3.2		11.4	2.2						
	35	30 s/s	30.1	3.4	1275-1213	11.4	1.7						84

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	30	3.4	1281-1234								84
	50	15	30	4.1				12.2	1		0.040	5 L	85
		15 s/s	30.1	4.4				12.2	2		0.040	5 L	
	65	26	30	4.7	1274-1241			12.2	3		0.100	5 L	
		28	30.3	4.9				12.2	4		0.140	5 L	
	80	45	29.9	5.2				12.2	5		0.140	5 L	
		45 s/s	30	5.4				12.2	6		0.120	5 L	
	85	50	30	5.6									
	95	60	30	6	1283-1252			12.2	7		0.100	5 L	85
		60 s/s	30.2	6.3				12.2	8		0.080	5 L	
	110	75	30	6.7				12.2	9		0.040	5 L	
		75 s/s	30.1	6.6				12.2	10		0.060	5 L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	30.1	6.6	1303-1254	0	1.50						85
	112	2	30.0	7.5		11.4	2.10						
	115	4	29.8	8.1		11.4	1.70						
	125	15	29.9	9.1	1312-1270	11.4	1.60						
		30 s/s	29.8	9.6		11.4	4.10						86
	155	45	30.0	10.8		11.4	1.80						
	170	60 s/s	30.1	10.9	1317-1284	11.4	10.20						
	185	75	30.0	12.1		11.4	2.10						
		90 s/s	30.1	11.9		11.4	6.00						86
	215	105	30.1	13	1323-1315	11.4	3.50						
		120 s/s	30.3	12.8		11.4	8.30						
	245	135	29.8	13.6		11.4	3.10						
		150 s/s	30.2	13.3		11.4	7.60						
Water Coalescence Test - 3%	260	0	30.0	12.2	1337-1320		2.20						86
	262	2	29.7	15.3		3.4 L/min	14.90						
	265	5	30.3	17.4		3.4 L/min	13.50						
		10 s/s	30.1	18.5	1215	3.4 L/min	5.70						
		20 s/s	29.9	19.5		3.4 L/min	7.60						
	290	30	29.8	20.9	1224	3.4 L/min	12.90						87

JP-8+100 with EI 1581 5th Edition M Category Elements

Test Specification: API/IP 1581 5th Edition				SET:							Date: 8/19/15		
				Full-Scale:									
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon					Type: -S		
Additive Addition		1-614MMTB				SO-606V5					Manufacturing Date:		
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	13,500	A	25.6	6541 g	1044	D	2,0			I	1,0		
Ending		B	0,15%	20.3 gal	1232	B	0,15%			II	15		
		C	15	766 g	980	C	15						
Used		D	1,0	102 g	950								
Mixing Time: 45 min							MSEP	Before	After				
Element Conditioning:		in-Situ		External				99	68				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	30.3	1.8	1249-1131								78
Water 0,01%	5	0	30	1.8	1253-1163		0.2						
	10	5	30.3	1.9		11.4	0.4						
	15	10 s/s	30.4	2.2		11.4	0.6						
	25	20 s/s	30.3	2.5		11.4	0.7						
	35	30 s/s	30.0	2.7	1250-1256	11.4	0.9						79

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	30	2.6	1248-1272								79
	50	15	29.8	2.6					1		0.000	4L	79
		15 s/s	30.1	2.7					2		0.025	4L	
	65	26	29.8	2.7	1245-1261				3		0.150	4L	80
		28	29.9	3.2					4		0.000	4L	
	80	45	30	3.9					5		0.075	4L	
		45 s/s	30.1	4.2					6		0.050	4L	
	85	50	30.2	4.4									
	95	60	30	4.9	1271-1230				7		0.000	4L	81
		60 s/s	29.9	5.4					8		0.100	4L	
	110	75	30	6.4					9		0.100	4L	
		75 s/s	29.9	6.7					10		0.000	4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	29.9	6.8	1272-1230	0	0.20						82
	112	2	30.0	7.2		11.4	0.20						
	115	4	3.4	8.7		11.4	0.30						
	125	15	29.8	12.6	1270-1272	11.4	0.80						82
		30 s/s	29.7	15.8		11.4	1.00						
	155	45	30.3	18		11.4	0.70						
	170	60 s/s	30.3	17.4	1240-1282	11.4	1.20						
	185	75	30.0	18		11.4	0.70						84
		90 s/s	30.2	17.2		11.4	1.20						
	215	105	29.8	17.6	1245-1279	11.4	0.60						
		120 s/s	30.2	16.7		11.4	1.20						
	245	135	29.9	17.1		11.4	0.50						
		150 s/s	30.0	16.9		11.4	1.80						
Water Coalescence Test - 3%	260	0	30.2	12	1044-1055		0.30						88
	262	2	29.8	24.9		3.4 L/m	2.00						
	265	5	29.7	34		3.4 L/m	9.60						
		10 s/s	30.0	42.5	1022-N/A	3.4 L/m	7.50						
		20 s/s	30.0	53.2		3.4 L/m	41.50						
	290	30	29.9	64.9	973-N/A	3.4 L/m	41.50						89

JP-8+100 (1:1 Dilution) with EI 1581 5th Edition M Category Elements
New Batch of +100 Additive

Test Specification: API/IP 1581 5th Edition				SET:							Date: 9/24/15		
				Full-Scale:									
Vessel:			Filter/Coalescer: Velcon			Separator: Velcon					Type: -S		
Additive Addition			1-674C5TB			SO-606V5					Manufacturing Date:		
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	14,000	A	25.6	2713 g	1063	D	2,0			I	1,0		
Ending		B	0,15%	21 gal	1070	B	0,15%			II	15		
		C	15	795 g	990	C	15						
Used		D	1,0	106 g	1025								
Mixing Time: 50 min							MSEP	Before	After				
Element Conditioning:		in-Situ		External				99	66				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	29.8	2.4	1091-899								77
Water 0,01%	5	0	30	2.4	1085-956		0.1						
	10	5	29.9	2.5		11.4	0.2						
	15	10	29.9	2.9		11.4	0.4						
	25	20	30	3.3		11.4	0.5						
	35	30	30.0	3.5	1086-1060	11.4	0.6						79

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	30	3.4	1094-1059								79
	50	15	30	3.7				1.74m	1		0.000	4L	
		15 s/s a)	30.1	2.7				1.74m	2		0.000	4L	
	65	30	30	3.1	1092-1027			1.74m	3		0.020	4L	80
		30 s/s	30.1	3.7				1.74m	4		0.000	4L	
	80	45	29.8	5.1				1.74m	5		0.040	4L	
		45 s/s	30	5.9				1.74m	6		0.020	4L	
	85	50	30	6.3				1.74m				4L	
	95	54	30	7	1090-1021			1.74m	-		-	4L	81
		60											
	110	75											
		75 s/s											

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	29.8	7	1098-1069	0	0.00						81
	112	2	30.1	7.6		11.4	0.00						
	115	5	29.8	8.9		11.4	0.20						
	125	15	30.0	12.5	1091-1084	11.4	0.60						81
		30 s/s	30.3	15.3		11.4	0.80						
	155	45	30.2	17.2		11.4	0.80						
	170	60 s/s	30.2	18.2	1087-1080	11.4	0.90						
	185	75	30.2	19.7		11.4	0.90						82
		90 s/s	30.3	19.7		11.4	1.10						
	215	105	30.0	21	1097-1141	11.4	1.00						
		120 s/s	30.3	20.6		11.4	1.50						
	245	135	30.0	21.5		11.4	1.10						
		150 s/s	30.3	21.3		11.4	1.70						
Water Coalescence Test - 3%	260	0	30.0	10.3	1104-1157		0.80						84
	262	2	30.1	29.4		3.4 L/m	2.40						
	265	5	30.1	37.1		3.4 L/m	1.80						
		10 s/s	30.0	49.3	1119-1054	3.4 L/m	14.20						
		15	29.7	61.4		3.4 L/m	wash-out						
	290	30											

JP-8+100 (5:1 Dilution) with EI 1581 5th Edition C Category Elements
New Batch of +100 Additive

Test Specification: API/IP 1581 5th Edition				SET:							Date: 11/6/15		
				Full-Scale:									
Vessel:			Filter/Coalescer: Velcon			Separator: Velcon					Type: -S		
Additive Addition			1-614MMTB			SO-606V5					Manufacturing Date:		
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	14,000	A	25.6	1356.7 g	820	D	2,0			I	1,0		
Ending		B	0,15%	21 gal		B	0,15%			II	15		
		C	15	794.9 g	857	C	15						
Used		D	1,0	106 g	869								
Mixing Time: 50 min							MSEP	Before	After				
Element Conditioning:		in-Situ		External				99	74				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	30.5	2.8	980/673								73
Water 0,01%	5	0	30.4	2.9	959/706		0.2						
	10	5	30.3	3.1		11.4	0.2						
	15	10	30.6	3.6		11.4	0.3						
	25	20	30.4	3.9		11.4	0.4						
	35	30	30.3	4	964/815	11.4	0.3						73

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	30	4	965/821								73
	50	15	30	5.3				19	1		0.000	4.000	73
		15s/s	30	5.4				19	2		0.075	4.000	
	65	30	29.6	6.3	968/854			19	3		0.025	4.000	73
		30s/s	29.9	5.8				19	4		0.050	4.000	
	80	45											
		45s/s											
	85	50											
	95	60											
		60s/s											
	110	75											
		75s/s											
			Stop solid test @35 min because we hit 7.5 differential pressure										
			Solids inj. 19mg/L @ 1.7 L/min										

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	29.8	7.3	965/865	0	0.40						73
	112	2	29.8	7.2		11.4	0.40						
	115	5	29.8	7.3		11.4	0.40						
	125	15	29.9	7.6	968/872	11.4	0.50						73
		30s/s	30.4	8.1		11.4	0.60						
	155	45	29.6	8.5		11.4	0.50						
	170	60s/s	30.3	9	980/877	11.4	0.70						
	185	75	29.9	9.3		11.4	0.60						73
		90s/s	30.0	9.9		11.4	1.10						
	215	105	30.0	10.2	974/871	11.4	0.80						
		120s/s	30.1	10.7		11.4	1.80						
	245	135	30.0	11		11.4	1.00						
		150s/s	30.1	11.2		11.4	1.20						
Water Coalescence Test - 3%	260	0	29.9	10.5	972/910		0.70						73
	262	2	30.2	13.4-16.1		3.4 L/m	43.10						
	265	5	30.3	19.1		3.4 L/m	43.10						
		10s/s											
		20s/s											
	290	30											

JP-8+100 (10:1 Dilution) with EI 1581 5th Edition M Category Elements
New Batch of +100 Additive

Test Specification: API/IP 1581 5th Edition				SET:								Date: 11/18/15	
				Full-Scale:									
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon						Type: -S	
Additive Addition		1-614MMTB				SO-606V5						Manufacturing Date:	
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	14,000	A	25.6	678.3 g	666	D	2,0			I	1,0		
Ending		B	0,15%	21 gal	860	B	0,15%			II	15		
		C	15	794.9 g	663	C	15						
Used		D	1,0	106 g	632								
Mixing Time: 50 min							MSEP	Before	After				
Element Conditioning:		in-Situ		External				99	74				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	29.8	1.8	850/460								72
Water 0,01%	5	0	29.8	1.8	810/470		0.1						
	10	5	30	2		11.4	0.1						
	15	10	30.1	2.3		11.4	0.1						
	25	20	29.9	2.6		11.4	0.2						
	35	30	30.0	2.9	810/660	11.4	0.2						71

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	30	2.8	800-680								71
	50	15	30	3.2				1.7	5		0.000	4.000	
		15s/s	30.2	3.3				1.7	6		0.000	4.000	
	65	30	30	3.4	810-730			1.7	7		0.000	4.000	72
		30s/s	30.1	3.5				1.7	8		0.050	4.000	
	80	45	30.2	3.6				1.7	9		0.025	4.000	
		45s/s	30.3	3.6				1.7	10		0.025	4.000	
	85	50	30.3	3.6				1.7				4.000	
	95	60	30	3.7	820-770			1.7	11		0.075	4.000	72
		60s/s	30	3.7				1.7	12		0.025	4.000	
	110	75	30	4.1				1.7	13		0.000	4.000	
		75s/s	30.3	4.4				1.7	14		0.075	4.000	
			Solids inj. 19mg/L @ 1.7 L/min										

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	30.2	4.5	830-750	0	0.10						72
	112	2	30.0	4.6		11.4	0.10						
	115	5	30.1	5.4		11.4	0.20						
	125	15	30.1	6.5	840-770	11.4	0.30						73
		30s/s	30.2	7.3		11.4	0.30						
	155	45	30.0	8		11.4	0.30						
	170	60s/s	30.3	8.5	820-820	11.4	0.30						
	185	75	30.0	8.8		11.4	0.30						73
		90s/s	30.1	9.2		11.4	0.30						
	215	105	29.9	9.7	830-810	11.4	0.30						
		120s/s	30.3	9.9		11.4	0.40						
	245	135	30.0	10.3		11.4	0.40						
		150s/s	30.1	10.4		11.4	0.50						
Water Coalescence Test - 3%	260	0	30.3	8.6	800-830	0	0.50						73
	262	2	30.4	14.2		3.4 L/m	1.90						
	265	5	30.3	18.9		3.4 L/m	37.30						
		10s/s	30.0	23.1	805-849	3.4 L/m	43.00						
		20s/s											
	290	30											

JP-8+100 (20:1 Dilution) with EI 1581 5th Edition M Category Elements
New Batch of +100 Additive

Test Specification: API/IP 1581 5th Edition				SET:							Date: 12/3/15		
				Full-Scale:									
Vessel:		Filter/Coalescer: Velcon				Separator: Velcon					Type: -S		
Additive Addition		1-614MMTB				SO-606V5					Manufacturing Date:		
Category:		M-100				M				C			
Tank Volume	Gallons	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)	Additive	Conc. (Mg/L)	Amount Added	k (pS/m)
Beginning	14,000	A	25.6	339	590	D	2,0			I	1,0		
Ending		B	0,15%	24 Gal		B	0,15%			II	15		
		C	15	794.95	590	C	15						
Used		D	1,0	106g	590								
Mixing Time: 50 min							MSEP	Before	After				
Element Conditioning:		in-Situ		External				99	74				

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Start-up	0	0	29.8	3.0	740-550								65
Water 0,01%	5	0	29.8	3	750-590		0.0						
	10	5	30.2	3.2		11.4	0.1						
	15	10	30.3	3.6		11.4	0.1						
	25	20	30.2	3.8		11.4	0.2						
	35	30	30.3	3.9	760-610	11.4	0.1						65

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Solids Holding Test (Continued until reaching 115 kPa (22,5 psid)	35	0	30.2	3.7	750-610								65
	50	15	30.1	4.2				1.74m	1		0.025	4L	
		15s/s	30.3	4.3				1.74m	2		0.050	4L	
	65	30	30.3	4.6	770-640			1.74m	3		0.000	4L	65
		30s/s	30.3	4.8				1.74m	4		0.075	4L	
	80	45	30.2	5.3				1.74m	5		0.000	4L	
		45s/s	30.2	5.6				1.74m	6		0.050	4L	
	85	50	30.1	5.8				1.74m				4L	
	95	60	30.2	6.4	750-680			1.74m	7		0.025	4L	65
		60s/s	30.3	6.6				1.74m	8		0.100	4L	
	110	75	29.9	7				1.74m	9		0.050	4L	
		75s/s	29.9	7.2				1.74m	10		0.075	4L	

Phase	Cum. Test Time (minutes)	Time (minutes)	Fuel Flow Rate (gpm)	ΔP (psid)	k (pS/m)	Water Flow Rate mL/min gpm	Water Concent. (ppm)	Solids Rate mg/L mg/gal	Filter Sample ID	Solids Concent. Affluent (mg/L)	Solids Concent. Effluent (mg/L)	Sample Size	Temp °C °F
Water Coalescence Test - 0.01%	110	0	29.9	6.9	730-660	0	0.30						65
	112	2	29.8	7.1		11.4	0.20						
	115	5	30.0	7.6		11.4	0.30						
	125	15	30.1	8	730-680	11.4	0.20						66
		30s/s	30.2	8		11.4	0.20						
	155	45	30.0	8.4		11.4	0.10						
	170	60s/s	30.2	8.7	770-730	11.4	0.40						
	185	75	30.1	9.3		11.4	0.40						66
		90s/s	30.3	9.5		11.4	0.70						
	215	105	30.2	9.8	770-730	11.4	0.50						
		120s/s	30.2	10		11.4	1.10						
	245	135	30.0	10.4		11.4	1.00						
		150s/s	30.3	10.5		11.4	0.90						
Water Coalescence Test - 3%	260	0	30.3	9.6	770-720	0	0.50						66
	262	2	30.1	15.3		3.4 L/m	43.70						
	265	5	29.8	19.8		3.4 L/m	43.70						
		10s/s											
		20s/s											
	290	30											

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JP-8+100 (40:1 Dilution) with EI 1581 5th Edition M Category Elements
New Batch of +100 Additive

APPENDIX B
PARTICLE COUNTING

ACM 20 ISO Codes				
Time, min	≥4	6	≥14	≥30
0	13	12	10	7
5	11	10	6	0
10 ss	13	12	8	6
20 ss	13	12	8	5
30 ss	14	13	9	6
0	16	15	10	7
15	12	11	8	7
15 ss	13	11	7	7
30	11	9	4	0
0	11	10	5	0
2	10	10	4	0
5	9	10	6	0
15	9	8	4	0
30 ss	10	8	5	0
45	11	10	7	7
60 ss	15	14	9	7
75	17	15	10	7
90 ss	17	16	12	7
105	17	16	12	7
120 ss	17	16	12	7
135	17	16	12	7
150 ss	17	16	12	7
0	17	16	13	8
2	17	16	12	8
5	17	16	12	7
10 ss	17	15	12	9
20 ss	17	16	12	9
30	17	16	12	9

JP-8 (DoD Elements)

ACM 20 ISO Codes				
Time, min	≥4	6	≥14	≥30
0	12	9	6	4
5	12	10	6	4
10 ss	12	10	5	4
20 ss	13	12	8	4
30 ss	14	13	9	4
0	15	13	8	0
15	15	13	8	4
15 ss	16	14	9	6
30	16	14	8	4
30 ss	16	14	8	4
45	15	14	8	4
0	14	13	8	0
2	13	11	7	0
5	12	10	6	0
15	14	12	8	4
30 ss	17	14	10	4
45	17	15	10	6
60 ss	17	15	10	6
75	17	15	10	4
90 ss	17	15	11	5
105	17	15	10	5
120 ss	17	16	11	6
135	17	15	11	5
150 ss	17	15	11	6
0	17	15	11	6
2	19	18	14	11
5	19	18	14	10
10 ss	21	20	15	11
20 ss	22	21	16	11
30	23	22	18	13

JP-8+100 (DoD Elements)

JP-8+100 – 10:1 Dilution – DoD Elements

(Test Date 7/30/2011)
Battery Failure – No data

ACM 20 ISO Codes				
Time, min	≥4	6	≥14	≥30
0	14	12	5	0
5	13	11	6	0
10 ss	13	11	6	0
20 ss	13	11	6	0
30 ss	13	12	6	4
0	13	11	8	0
15	12	11	7	0
15 ss	13	11	6	0
30	12	11	6	0
30 ss	12	10	6	4
45	11	10	4	0
0	11	9	4	0
2	10	9	5	0
5	10	9	5	0
15	11	10	6	4
30 ss	12	11	7	4
45	12	11	7	0
60 ss	14	12	8	5
75	14	12	9	4
90 ss	16	13	9	4
105	16	13	9	4
120 ss	17	15	9	4
135	17	15	9	4
150 ss	18	16	10	6
0	18	15	9	4
2	19	18	14	10
5	19	18	13	10
10 ss	20	18	14	10
20 ss	23	22	18	13
30	23	23	20	15

JP-8+100 – 5:1 Dilution – DoD Elements

(Test Date 7/11/2011)

JP-8+100 – 5:1 Dilution – DoD Elements
(Test Date 7/22/2011)
Battery Failure – No data

ACM 20 ISO Codes				
Time, min	≥4	6	≥14	≥30
0	14	13	9	0
5	14	13	9	0
10 ss	14	12	8	0
20 ss	13	12	8	4
30 ss	13	12	7	4
0	12	10	7	4
15	12	11	7	4
15 ss	12	11	6	0
30	13	11	6	0
30 ss	13	11	7	5
45	13	11	7	5
45 ss	12	10	7	5
60	12	11	7	5
60 ss	11	10	6	0
72	11	9	6	4
0	11	9	6	4
2	11	10	6	0
5	10	10	6	4
15	10	10	6	4
30 ss	11	11	7	4
45	11	11	7	0
60 ss	11	11	7	4
75	10	10	6	4
90 ss	11	11	8	4
105	11	11	8	0
120 ss	12	12	7	4
135	11	11	6	4
150 ss	11	11	7	4
0	12	12	7	4
2	16	16	12	9
5	16	16	12	10
10 ss	17	17	12	10
20 ss	19	17	12	10
30	21	19	14	11

JP-8 EI 1581 M Category Elements (Test date 8/4/2011)

ACM 20 ISO Codes				
Time, min	≥4	6	≥14	≥30
0	13	11	5	4
5	14	12	4	0
10 ss	15	13	7	0
20 ss	15	15	8	4
30 ss	16	14	9	5
0	15	13	8	0
15	15	13	9	4
15 ss	15	14	10	4
30	14	13	8	4
30 ss	15	14	10	5
45	14	13	9	4
45 ss	14	13	9	4
0	14	13	10	4
2	14	13	9	5
5	15	14	11	8
15	14	13	9	6
30 ss	15	14	11	8
45	14	13	10	6
60 ss	14	14	11	8
75	13	13	9	4
90 ss	14	14	11	9
105	14	14	10	7
120 ss	15	15	12	9
135	14	15	10	7
150 ss	17	16	12	9
0	13	13	9	6
2	22	20	16	14
5	20	19	13	11
10 ss	20	18	13	10
20 ss	20	18	13	10
30	21	19	14	13

JP-8+100 – EI 1581 M Category Elements (Test date 8/12/2011)

ACM 20 ISO Codes				
Time, min	≥4	6	≥14	≥30
0	14	12	5	0
5	15	12	7	0
10 ss	17	14	8	0
20 ss	18	15	8	4
30 ss	19	16	9	4
0	19	16	8	0
15	19	17	9	0
15 ss	19	17	9	4
30	20	17	9	0
30 ss	19	17	9	4
45	20	18	10	0
45 ss	20	17	10	0
60	20	17	10	4
60 ss	20	18	10	0
72	20	17	10	0
0	19	17	10	0
2	19	17	10	0
5	19	17	11	0
15	20	17	11	4
30 ss	20	18	11	6
45	20	18	12	0
60 ss	20	18	12	4
75	20	18	12	6
90 ss	20	18	12	5
105	20	18	12	5
120 ss	20	18	12	4
135	20	18	12	6
150 ss	20	18	12	6
0	20	18	12	6
2	20	18	12	5
5	20	19	16	13
10 ss	20	19	16	13
20 ss	21	20	17	14
30	22	20	17	14

JP-8+100 (10:1 dilution) – EI 1581 M Category Elements (Test date 8/25/2011)

ACM 20 ISO Codes				
Time, min	≥4	6	≥14	≥30
0	14	12	5	0
5	15	12	7	0
10 ss	17	14	8	0
20 ss	18	15	8	4
30 ss	19	16	9	4
0	19	16	8	0
15	21	17	9	0
15 ss	19	17	9	4
30	21	17	9	0
30 ss	20	17	9	4
45	21	18	10	4
0	21	17	10	0
2	21	17	10	4
5	21	18	10	0
15	21	17	10	0
30 ss	21	17	10	0
45	20	17	10	0
60 ss	20	17	10	0
75	21	17	11	4
90 ss	21	18	11	6
105	21	18	12	0
120 ss	21	18	12	4
135	21	18	12	6
150 ss	21	18	12	8
0	21	18	12	9
2	21	18	12	7
5	21	18	12	9
10 ss	21	18	12	9
20 ss	21	18	12	7
30	21	18	12	5

JP-8+100 (10:1 dilution) – EI 1581 M Category Elements (Test date 9/2/2011)

ACM 20 ISO Codes				
Time, min	≥4	6	≥14	≥30
0	15	13	8	4
5	15	12	4	0
10 ss	15	13	7	4
20 ss	16	13	8	4
30 ss	17	14	4	0
0	18	15	4	4
15	17	15	0	0
15 ss	17	14	0	0
30	14	12	0	0
30 ss	15	12	4	4
45	13	12	5	4
0	13	11	0	0
2	13	11	0	0
5	13	11	4	4
15	13	12	4	4
30 ss	15	13	4	4
45	16	13	4	4
60 ss	14	14	7	6
75	18	15	6	4
90 ss	18	15	9	8
105	18	16	6	4
120 ss	18	16	9	8
135	19	16	6	6
150 ss	18	16	7	9
0	19	16	6	5
2	19	18	12	12
5	19	18	12	11
10 ss	20	18	13	12
20 ss	22	21	15	14
30	23	22	16	14

JP-8+100– EI 1581 M100 Category Elements (Test date 9/15/2011)

ACM 20 ISO Codes				
Time, min	≥4	6	≥14	≥30
0	15	13	7	4
5	14	12	7	4
10 ss	13	11	5	4
20 ss	13	12	7	0
30 ss	14	13	9	5
0	14	12	9	4
15	15	12	7	0
15 ss	14	12	6	0
30	14	12	8	0
30 ss	14	12	7	0
45	12	11	7	0
45 ss	12	11	7	0
60	12	11	6	0
60 ss	12	11	6	4
0	12	10	6	4
2	12	10	6	0
5	12	11	6	0
15	11	10	5	0
30 ss	12	11	5	5
45	13	12	8	4
60 ss	14	12	9	6
75	13	12	8	4
90 ss	14	12	9	4
105	15	13	10	7
120 ss	16	13	9	7
135	16	14	11	8
150 ss	16	14	10	7
0	17	15	11	8
2	17	14	8	4
5	18	17	14	11
10 ss	20	18	14	12
20 ss	22	21	17	15
30	22	21	19	17

JP-8+100 (5:1 dilution) – EI 1581 M Category Elements (Test date 9/29/2011)

ACM 20 ISO Codes				
Time, min	≥4	≥6	≥14	≥30
0	12	10	5	0
5	11	9	4	0
10 ss	11	9	0	0
20 ss	11	10	4	0
30 ss	12	11	7	4
0	12	10	6	0
15	12	10	4	0
15 ss	12	10	5	4
30	11	10	5	0
30 ss	12	10	5	0
45	11	9	4	0
45 ss	12	10	6	0
0	11	9	6	4
2	11	9	4	0
5	11	10	6	0
15	10	8	4	0
30 ss	11	9	4	0
45	11	9	4	0
60 ss	12	11	8	5
75	12	11	8	5
90 ss	12	11	8	4
105	13	11	8	4
120 ss	12	11	8	4
135	13	12	8	4
150 ss	12	11	8	4
0	13	12	9	6
2	13	12	8	4
5	14	12	9	4
10 ss	13	11	9	4
20 ss	18	17	14	13
30	22	21	17	14

JP-8+100 (10:1 dilution) – EI 1581 M Category Elements (Test date 10/19/2011)

ACM 20 ISO Codes				
Time, min	≥4	≥6	≥14	≥30
0	13	11	5	0
5	12	10	6	0
10 ss	10	9	6	0
20 ss	11	10	7	0
30 ss	12	11	7	0
0	11	10	8	4
15	10	10	6	0
15 ss	11	10	6	0
30	11	10	6	0
0	10	9	6	0
2	11	9	8	0
5	12	11	7	0
15	12	11	7	0
30 ss	12	11	8	4
45	12	11	7	4
60 ss	13	11	9	4
75	12	10	7	4
90 ss	13	12	9	4
105	12	11	7	4
120 ss	13	11	9	5
135	12	11	8	5
150 ss	13	12	9	7
0	11	10	7	4
2	17	15	12	9
5	17	15	12	9
10 ss	17	15	12	9
20 ss	17	16	13	12
30	17	16	14	13

JP-8– EI 1581 M Category Elements (Test date 10/27/2011)

ACM 20 ISO Codes				
Time, min	≥4	6	≥14	≥30
0	15	13	8	6
5	15	13	8	0
10 ss	14	13	8	0
20 ss	15	13	8	4
30 ss	14	13	8	4
0	15	13	7	4
15	15	13	8	5
15 ss	14	12	7	4
0	13	12	7	0
2	12	12	6	0
5	12	12	6	0
15	12	12	7	0
30 ss	13	13	7	4
45	13	13	8	4
60 ss	14	14	9	6
75	14	14	10	6
90 ss	15	15	11	7
105	15	15	11	6
120 ss	16	16	11	7
135	15	15	11	5
150 ss	16	16	11	5
0	15	15	9	5
2	12	12	9	5
5	19	18	15	11
10 ss	20	20	16	11
20 ss	22	22	19	15
30	23	23	21	17

JP-8+100 (1:1 dilution) – EI 1581 M Category Elements (Test date 7/28/2011)

ACM 20 ISO Codes				
Time, min	≥4	≥6	≥14	≥30
0	15	14	11	9
5	15	12	4	4
10 ss	15	12	7	4
20 ss	15	13	8	0
30 ss	15	13	8	0
0	15	13	8	4
15	14	13	6	4
15 ss	15	13	9	6
30	14	13	7	0
30 ss	15	12	8	0
45	14	13	7	4
0	14	13	8	0
2	14	12	6	0
5	14	12	7	0
15	14	12	7	0
30 ss	14	12	7	4
45	14	12	9	6
60 ss	14	13	9	5
75	14	12	9	0
90 ss	15	13	10	4
105	14	12	9	4
120 ss	15	13	11	7
135	14	12	10	6
150 ss	15	13	11	4
0	14	12	9	4
2	15	14	11	8
5	14	12	10	4
10 ss	20	18	14	13
20 ss	23	21	17	14
30	23	22	19	16

JP-8+100 (1:1 dilution) – EI 1581 M Category Elements (Test date 11/15/2011)

	ACM 20 ISO codes					
	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
0	12	11	8	>6	>5	>4
5	12	10	9	>6	>5	>4
10 ss	11	10	7	>6	>5	>0
20 ss	11	10	8	8	>6	>6
30 ss	12	11	8	>6	>6	>5
0	12	11	8	>5	>5	>0
15	12	11	8	7	>6	>4
15 ss	12	11	9	7	>6	>5
30	12	11	8	>6	>5	>4
30 ss	12	11	8	7	>6	>6
45	12	11	9	7	>6	>3
45 ss	12	11	8	>6	>5	>3
60	12	11	9	7	7	>6
60 ss	12	11	8	>6	>5	>5
72	12	11	8	7	>6	>5
0	12	11	9	7	>6	>5
2	12	11	8	7	>6	>4
5	12	10	7	>6	>4	>3
15	12	11	8	7	>6	>5
30 ss	14	13	10	9	8	7
45	12	11	9	7	7	>6
60 ss	13	12	9	7	7	>5
75	12	11	9	7	7	>6
90 ss	14	12	10	8	8	>6
105	13	12	10	8	8	7
120 ss	14	12	10	7	>6	>6
135	13	11	9	8	7	>5
150 ss	14	12	10	8	7	>4
0	12	11	9	9	8	>6
2	16	15	12	11	10	9
5	16	15	11	10	9	8
10 ss	16	15	12	11	10	9
20 ss	17	15	12	11	10	9
30	17	16	12	11	10	9

JP-8 (Test date 5/4/2015)

	SETA ISO codes					
	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
0	14	12	7	5	4	0
5	13	11	6	5	4	4
10 ss	14	13	10	9	8	7
20 ss	14	12	9	9	8	8
30 ss	14	12	9	7	7	6
0	15	12	8	7	6	6
15	15	13	10	7	6	4
15 ss	18	16	13	11	9	7
30	16	14	11	10	8	6
30 ss	18	16	13	11	9	7
45	15	14	12	10	9	7
45 ss	17	16	13	11	9	7
60	16	15	12	11	9	7
60 ss	17	16	12	11	9	7
72	16	15	13	12	10	8
0	15	14	12	10	8	5
2	15	15	12	10	7	5
5	15	14	12	10	7	5
15	16	15	12	10	8	6
30 ss	18	17	14	13	11	9
45	16	15	13	12	10	8
60 ss	18	16	13	12	10	8
75	16	15	13	11	9	7
90 ss	17	16	12	10	9	7
105	15	14	12	10	8	7
120 ss	16	14	11	9	7	5
135	14	14	10	8	6	5
150 ss	16	14	10	8	7	5
0	14	13	10	7	5	0
2	16	15	13	10	9	8
5	16	15	13	11	10	9
10 ss	17	16	13	11	11	10
20 ss	18	16	14	12	11	10
30	17	16	14	12	11	10

JP-8 (Test date 5/4/2015)

	PARKER IOS codes			
	≥4 um	≥6 um	≥14 um	≥30 um
0	13	12	10	>6
5	13	12	10	>6
10 ss	14	12	10	>8
20 ss	16	15	13	10
30 ss	15	13	10	>6
0	15	14	11	>8
15	16	14	12	>9
15 ss	15	14	11	9
30	16	14	12	9
30 ss	16	14	12	>8
45	16	14	12	>8
45 ss	16	14	12	9
60	16	15	13	>8
60 ss	16	14	12	>8
72	16	15	12	9
0	16	15	13	9
2	16	14	12	>8
5	16	15	12	9
15	16	15	12	9
30 ss				
45	16	15	13	9
60 ss	18	17	15	13
75	16	15	13	10
90 ss	16	15	13	9
105	17	15	14	10
120 ss	16	15	13	9
135	16	15	13	10
150 ss	16	15	13	10
0	16	15	13	10
2	17	15	13	10
5	17	15	13	11
10 ss	17	15	13	11
20 ss	18	16	14	11
30	18	16	14	11

JP-8 (Test date 5/4/2015)

	ACM 20 ISO codes					
	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
0	18	17	12	9	8	7
5	18	16	12	9	8	8
10 ss	18	16	12	9	8	7
20 ss	17	16	12	10	9	9
30 ss	17	16	12	9	8	7
0	17	16	12	10	8	8
15	18	16	13	11	10	10
15 ss	18	16	12	10	9	8
30	17	15	12	9	8	7
30 ss	19	15	12	9	8	7
45	17	15	11	9	9	8
45 ss	19	15	11	9	9	8
60	17	15	11	9	8	7
60 ss	17	15	11	9	8	>6
75	17	15	11	9	8	7
75 ss	19	16	11	9	8	8
0	17	15	11	9	8	7
2	17	15	11	9	8	7
5	17	15	11	10	9	8
15	18	15	12	10	9	9
30 ss	20	17	12	11	10	9
45	17	15	12	10	9	8
60 ss	20	16	12	11	10	10
75	18	15	12	11	10	10
90 ss	20	17	13	11	11	10
105	18	16	13	12	11	10
120 ss	20	17	13	11	11	10
135	18	15	13	12	11	10
150 ss	19	17	13	12	11	11
0	17	15	12	10	10	9
2	21	18	15	14	13	13
5	20	18	15	13	13	12
10 ss	21	19	15	14	13	12
20 ss	21	19	15	14	13	12
30	20	19	15	14	14	13

JP-8+100 (Test date 5/19/2015)

	SETA ISO codes					
	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
0	19	17	13	11	10	9
5	17	16	12	10	9	9
10 ss	19	17	14	12	11	10
20 ss	18	17	14	13	12	11
30 ss	18	16	13	11	11	10
0	16	15	12	10	10	9
15	18	14	11	9	8	7
15 ss	18	15	12	10	9	9
30	17	14	11	9	9	8
30 ss	18	15	11	10	9	8
45	18	14	10	9	8	7
45 ss	18	14	11	9	9	8
60	18	14	10	9	8	7
60 ss	18	14	10	9	8	7
75	17	14	10	9	8	7
75 ss	17	14	10	8	7	7
0	17	14	10	8	7	6
2	19	14	10	8	7	6
5	19	15	11	9	8	7
15	19	15	11	10	8	7
30 ss	19	15	12	10	9	8
45	19	15	12	10	9	8
60 ss	19	16	12	11	9	9
75	19	16	12	11	10	8
90 ss	21	18	16	15	14	14
105	19	16	12	11	10	9
120 ss	19	16	13	11	10	9
135	20	16	13	11	10	9
150 ss	20	16	13	11	10	10
0	19	15	12	10	9	9
2	22	19	15	14	13	12
5	22	19	16	14	13	12
10 ss	22	19	16	14	13	12
20 ss	22	19	16	14	13	13
30	22	20	16	14	14	13

JP-8+100 (Test date 5/19/2015)

	PARKER IOS codes			
	≥4 um	≥6 um	≥14 um	≥30 um
0	18	16	14	11
5	18	16	14	12
10 ss	20	19	18	16
20 ss	18	16	14	12
30 ss	17	16	13	11
0	18	16	14	12
15	17	16	14	11
15 ss	17	16	14	11
30	17	16	13	11
30 ss	17	16	14	12
45	17	16	14	11
45 ss	19	19	17	15
60	17	16	13	10
60 ss	17	16	13	10
75	17	16	14	11
75 ss	19	18	14	14
0	19	18	14	11
2	19	18	17	15
5	18	16	14	11
15	18	16	14	11
30 ss	18	16	14	11
45	19	17	15	12
60 ss	18	17	15	12
75	20	19	17	15
90 ss	19	17	15	12
105	19	18	16	13
120 ss	19	18	16	13
135	20	19	17	14
150 ss	20	19	17	14
0	19	18	17	14
2	21	20	18	16
5	20	19	18	16
10 ss	20	19	18	16
20 ss	21	19	18	16
30	21	19	18	16

JP-8+100 (Test date 5/19/2015)

	ACM 20 ISO codes					
	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
0	18	17	12	9	8	7
5	18	16	12	9	8	8
10 ss	18	16	12	9	8	7
20 ss	17	16	12	10	9	9
30 ss	17	16	12	9	8	7
0	17	16	12	10	8	8
15	18	16	13	11	10	10
15 ss	18	16	12	10	9	8
30	17	15	12	9	8	7
30 ss	19	15	12	9	8	7
45	17	15	11	9	9	8
45 ss	19	15	11	9	9	8
60	17	15	11	9	8	7
60 ss	17	15	11	9	8	>6
75	17	15	11	9	8	7
75 ss	19	16	11	9	8	8
0	17	15	11	9	8	7
2	17	15	11	9	8	7
5	17	15	11	10	9	8
15	18	15	12	10	9	9
30 ss	20	17	12	11	10	9
45	17	15	12	10	9	8
60 ss	20	16	12	11	10	10
75	18	15	12	11	10	10
90 ss	20	17	13	11	11	10
105	18	16	13	12	11	10
120 ss	20	17	13	11	11	10
135	18	15	13	12	11	10
150 ss	19	17	13	12	11	11
0	17	15	12	10	10	9
2	21	18	15	14	13	13
5	20	18	15	13	13	12
10 ss	21	19	15	14	13	12
20 ss	21	19	15	14	13	12
30	20	19	15	14	14	13

JP-8+100 1:1 Dilution (Test date 8/19/2015)
New Batch of +100 Additive

	SETA ISO codes					
	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
0	19	17	13	11	10	9
5	17	16	12	10	9	9
10 ss	19	17	14	12	11	10
20 ss	18	17	14	13	12	11
30 ss	18	16	13	11	11	10
0	16	15	12	10	10	9
15	18	14	11	9	8	7
15 ss	18	15	12	10	9	9
30	17	14	11	9	9	8
30 ss	18	15	11	10	9	8
45	18	14	10	9	8	7
45 ss	18	14	11	9	9	8
60	18	14	10	9	8	7
60 ss	18	14	10	9	8	7
75	17	14	10	9	8	7
75 ss	17	14	10	8	7	7
0	17	14	10	8	7	6
2	19	14	10	8	7	6
5	19	15	11	9	8	7
15	19	15	11	10	8	7
30 ss	19	15	12	10	9	8
45	19	15	12	10	9	8
60 ss	19	16	12	11	9	9
75	19	16	12	11	10	8
90 ss	21	18	16	15	14	14
105	19	16	12	11	10	9
120 ss	19	16	13	11	10	9
135	20	16	13	11	10	9
150 ss	20	16	13	11	10	10
0	19	15	12	10	9	9
2	22	19	15	14	13	12
5	22	19	16	14	13	12
10 ss	22	19	16	14	13	12
20 ss	22	19	16	14	13	13
30	22	20	16	14	14	13

JP-8+100 1:1 Dilution (Test date 8/19/2015)
New Batch of +100 Additive

	PARKER IOS codes			
	≥4 um	≥6 um	≥14 um	≥30 um
0	18	16	14	11
5	18	16	14	12
10 ss	20	19	18	16
20 ss	18	16	14	12
30 ss	17	16	13	11
0	18	16	14	12
15	17	16	14	11
15 ss	17	16	14	11
30	17	16	13	11
30 ss	17	16	14	12
45	17	16	14	11
45 ss	19	19	17	15
60	17	16	13	10
60 ss	17	16	13	10
75	17	16	14	11
75 ss	19	18	14	14
0	19	18	14	11
2	19	18	17	15
5	18	16	14	11
15	18	16	14	11
30 ss	18	16	14	11
45	19	17	15	12
60 ss	18	17	15	12
75	20	19	17	15
90 ss	19	17	15	12
105	19	18	16	13
120 ss	19	18	16	13
135	20	19	17	14
150 ss	20	19	17	14
0	19	18	17	14
2	21	20	18	16
5	20	19	18	16
10 ss	20	19	18	16
20 ss	21	19	18	16
30	21	19	18	16

JP-8+100 1:1 Dilution (Test date 8/19/2015)
New Batch of +100 Additive

	ACM 20: ISO 4406 Codes					
	≥4 um	**≥6 um**	**≥14 um**	**≥21 um**	**≥25 um**	**≥30 um**
1/2 Dose	19	17	13	11	10	9
5	19	17	13	11	9	8
10SS	19	17	13	11	10	9
20SS	19	17	13	11	10	9
30SS	18	17	13	10	9	8
0	18	17	13	10	9	9
15	18	17	13	10	9	8
15SS	18	16	13	10	9	8
30	18	16	12	10	9	9
30SS	18	16	12	10	9	8
45	17	16	12	10	9	8
45SS	18	16	12	10	8	>6
60	17	15	11	9	8	7
60SS	17	16	12	9	8	7
75	17	15	12	9	9	8
75SS	17	15	11	9	8	7
0	16	15	11	9	8	8
2	17	15	11	9	8	7
5	17	15	11	9	8	7
15	17	15	11	8	8	>6
30	16	15	11	9	7	>6
45	16	15	11	8	7	>6
60SS	19	15	11	9	8	>6
75	16	14	10	7	>6	>5
90SS	18	15	10	8	>6	>4
105	15	14	10	7	>6	>5
120SS	18	14	10	8	7	>6
135	15	14	10	7	7	5
150SS	18	14	10	7	>6	>3
0	16	14	9	7	>6	>6
2	18	16	13	12	11	10
10SS	21	19	13	12	11	10
20SS	22	22	19	17	16	14
30	99	22	20	18	17	15

JP-8+100 5:1 Dilution (Test date 10/23/2015)
New Batch of +100 Additive

	SETA: ISO 4406 Codes					
	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
0	12.0	11.0	9.0	8.0	7.0	6.0
5	12.0	10.0	8.0	6.0	5.0	5.0
10SS	13.0	12.0	10.0	8.0	6.0	4.0
20SS	13.0	11.0	9.0	8.0	7.0	6.0
30SS	13.0	11.0	9.0	7.0	6.0	5.0
0	12.0	10.0	7.0	5.0	4.0	4.0
15	15.0	11.0	7.0	6.0	5.0	4.0
15SS	15.0	11.0	8.0	6.0	5.0	4.0
30	14.0	11.0	7.0	6.0	5.0	5.0
30SS	13.0	10.0	7.0	5.0	5.0	0.0
45	13.0	9.0	7.0	6.0	5.0	5.0
45SS	14.0	10.0	8.0	7.0	6.0	5.0
60	13.0	9.0	6.0	4.0	4.0	4.0
60SS	14.0	11.0	8.0	7.0	6.0	5.0
75	13.0	10.0	7.0	5.0	5.0	4.0
75SS	14.0	12.0	8.0	7.0	6.0	5.0
0	12.0	9.0	5.0	4.0	4.0	4.0
2	16.0	9.0	5.0	0.0	0.0	0.0
5	16.0	9.0	4.0	0.0	0.0	0.0
15	16.0	10.0	7.0	5.0	0.0	0.0
30SS	16.0	11.0	8.0	5.0	0.0	0.0
45	14.0	11.0	8.0	7.0	6.0	6.0
60SS	15.0	12.0	9.0	7.0	6.0	5.0
75	14.0	11.0	8.0	6.0	5.0	4.0
90SS	15.0	12.0	8.0	6.0	4.0	0.0
105	15.0	12.0	8.0	6.0	5.0	0.0
120SS	17.0	14.0	8.0	5.0	4.0	0.0
135	17.0	14.0	8.0	5.0	4.0	0.0
150SS	18.0	14.0	9.0	5.0	4.0	0.0
0	18.0	15.0	8.0	5.0	4.0	0.0
2	19.0	17.0	14.0	12.0	11.0	10.0
5	21.0	19.0	14.0	12.0	12.0	11.0
10SS	22.0	20.0	15.0	13.0	12.0	11.0
20SS	23.0	22.0	18.0	16.0	15.0	14.0
30	23.0	23.0	20.0	18.0	17.0	16.0

JP-8+100 5:1 Dilution (Test date 10/23/2015)
New Batch of +100 Additive

	ACM 20: ISO 4406 Codes					
	≥4 um	**≥6 um**	**≥14 um**	**≥21 um**	**≥25 um**	**≥30 um**
1/2 Dose	19	17	13	11	10	9
5	19	17	13	11	9	8
10SS	19	17	13	11	10	9
20SS	19	17	13	11	10	9
30SS	18	17	13	10	9	8
0	18	17	13	10	9	9
15	18	17	13	10	9	8
15SS	18	16	13	10	9	8
30	18	16	12	10	9	9
30SS	18	16	12	10	9	8
45	17	16	12	10	9	8
45SS	18	16	12	10	8	>6
60	17	15	11	9	8	7
60SS	17	16	12	9	8	7
75	17	15	12	9	9	8
75SS	17	15	11	9	8	7
0	16	15	11	9	8	8
2	17	15	11	9	8	7
5	17	15	11	9	8	7
15	17	15	11	8	8	>6
30	16	15	11	9	7	>6
45	16	15	11	8	7	>6
60SS	19	15	11	9	8	>6
75	16	14	10	7	>6	>5
90SS	18	15	10	8	>6	>4
105	15	14	10	7	>6	>5
120SS	18	14	10	8	7	>6
135	15	14	10	7	7	5
150SS	18	14	10	7	>6	>3
0	16	14	9	7	>6	>6
2	18	16	13	12	11	10
10SS	21	19	13	12	11	10
20SS	22	22	19	17	16	14
30	99	22	20	18	17	15

JP-8+100 10:1 Dilution (Test date 11/6/2015)
New Batch of +100 Additive

	SETA: ISO 4406 Codes					
	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
0	12.0	11.0	9.0	8.0	7.0	6.0
5	12.0	10.0	8.0	6.0	5.0	5.0
10SS	13.0	12.0	10.0	8.0	6.0	4.0
20SS	13.0	11.0	9.0	8.0	7.0	6.0
30SS	13.0	11.0	9.0	7.0	6.0	5.0
0	12.0	10.0	7.0	5.0	4.0	4.0
15	15.0	11.0	7.0	6.0	5.0	4.0
15SS	15.0	11.0	8.0	6.0	5.0	4.0
30	14.0	11.0	7.0	6.0	5.0	5.0
30SS	13.0	10.0	7.0	5.0	5.0	0.0
45	13.0	9.0	7.0	6.0	5.0	5.0
45SS	14.0	10.0	8.0	7.0	6.0	5.0
60	13.0	9.0	6.0	4.0	4.0	4.0
60SS	14.0	11.0	8.0	7.0	6.0	5.0
75	13.0	10.0	7.0	5.0	5.0	4.0
75SS	14.0	12.0	8.0	7.0	6.0	5.0
0	12.0	9.0	5.0	4.0	4.0	4.0
2	16.0	9.0	5.0	0.0	0.0	0.0
5	16.0	9.0	4.0	0.0	0.0	0.0
15	16.0	10.0	7.0	5.0	0.0	0.0
30SS	16.0	11.0	8.0	5.0	0.0	0.0
45	14.0	11.0	8.0	7.0	6.0	6.0
60SS	15.0	12.0	9.0	7.0	6.0	5.0
75	14.0	11.0	8.0	6.0	5.0	4.0
90SS	15.0	12.0	8.0	6.0	4.0	0.0
105	15.0	12.0	8.0	6.0	5.0	0.0
120SS	17.0	14.0	8.0	5.0	4.0	0.0
135	17.0	14.0	8.0	5.0	4.0	0.0
150SS	18.0	14.0	9.0	5.0	4.0	0.0
0	18.0	15.0	8.0	5.0	4.0	0.0
2	19.0	17.0	14.0	12.0	11.0	10.0
5	21.0	19.0	14.0	12.0	12.0	11.0
10SS	22.0	20.0	15.0	13.0	12.0	11.0
20SS	23.0	22.0	18.0	16.0	15.0	14.0
30	23.0	23.0	20.0	18.0	17.0	16.0

JP-8+100 10:1 Dilution (Test date 11/6/2015)
New Batch of +100 Additive

	ACM 20: ISO 4406 Codes					
	≥4µm	≥6µm	≥14µm	≥21µm	≥25µm	≥30µm
0	13	11	7	>6	>5	>5
5	11	10	>6	>0	>0	>0
10SS	12	11	>6	>0	>0	>0
20SS	12	11	>5	>0	>0	>0
30SS	13	12	7	>6	>4	>4
0	13	11	7	>4	>3	>3
15	13	11	>6	>4	>3	>0
15SS	14	13	8	>6	>4	>0
30	12	11	>6	>0	>0	>0
30SS	14	12	7	>4	>3	>3
45	12	11	7	>5	>0	>0
45SS	14	12	7	>0	>0	>0
60	12	10	>6	>0	>0	>0
60SS	14	12	8	>3	>0	>0
75	12	10	7	>4	>0	>0
75SS	14	12	7	>3	>0	>0
0	11	9	>6	>4	>0	>0
2	11	9	>4	>0	>0	>0
5	11	9	>3	>3	>3	>0
15	12	10	8	>5	>3	>0
30SS	14	11	8	>5	>0	>0
45	12	11	8	>6	>3	>0
60SS	14	12	9	7	>6	>5
75	12	11	8	>3	>3	>0
90	14	12	9	7	>6	>5
105	13	11	9	7	>6	>4
120SS	14	12	9	7	>6	>5
135	13	12	9	8	>6	>5
150SS	14	12	9	8	7	>5
0	12	10	>6	>5	>5	>0
2	18	16	13	12	11	10
5	18	16	13	12	11	10
10SS	18	17	13	12	11	10

JP-8+100 20:1 Dilution (Test date 11/18/2015)
New Batch of +100 Additive

	Seta: ISO 4406 Codes					
	≥4µm	≥6µm	≥14µm	≥21µm	≥25µm	≥30µm
0	14	14	12	10	8	6
5	13	12	10	9	7	6
10SS	14	14	12	11	10	8
20SS	14	13	11	9	8	6
30SS	14	13	11	9	8	7
0	12	12	10	8	6	4
15	13	11	9	7	5	5
15SS	14	12	10	8	7	6
30	13	11	9	7	5	4
30SS	13	11	9	7	7	5
45	13	10	8	7	5	0
45SS	13	11	8	7	6	5
60	13	10	8	5	4	0
60SS	13	11	8	7	6	5
75	14	10	8	7	5	4
75SS	14	10	8	7	5	4
0	11	9	8	7	5	4
2	13	9	7	6	5	4
5	13	9	7	7	5	4
15	13	11	9	7	5	4
30SS	13	11	9	8	7	5
45	13	11	9	8	6	4
60SS	13	11	9	8	6	5
75	13	11	9	8	6	4
90	13	12	10	8	6	4
105	13	12	10	8	6	4
120SS	13	12	10	9	7	6
135	13	12	10	8	4	5
150SS	13	12	10	9	7	6
0	12	10	8	7	6	5
2	17	16	14	12	11	11
5	18	17	14	12	12	11
10SS	18	17	14	13	12	12

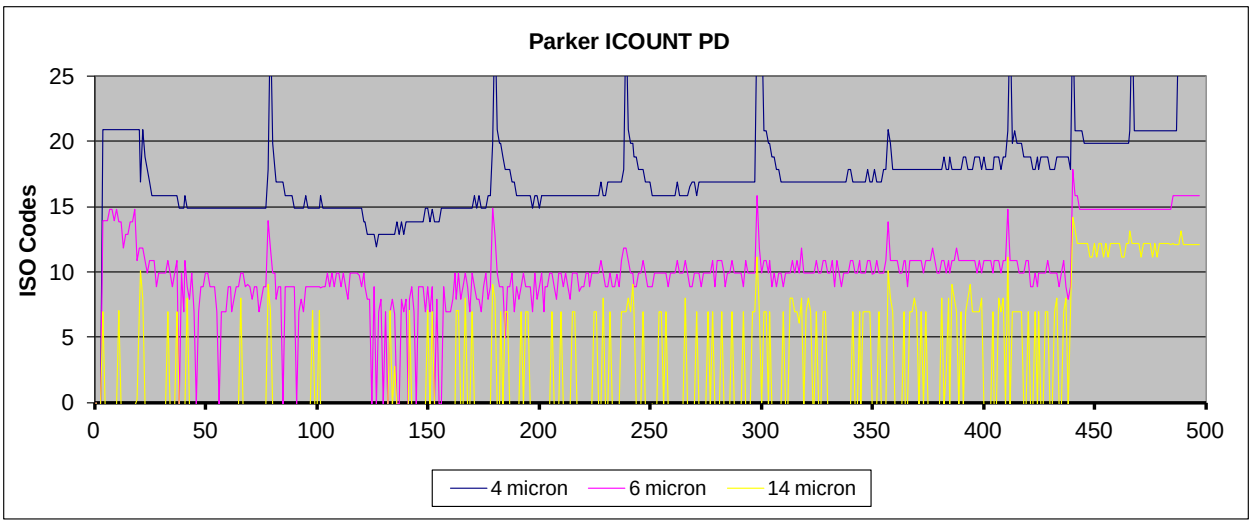
JP-8+100 20:1 Dilution (Test date 11/18/2015)
New Batch of +100 Additive

	ACM 20: ISO 4406 Codes					
	≥ 4 µm	**≥ 6 µm**	**≥ 14 µm**	**≥ 21 µm**	**≥ 25 µm**	**≥ 30 µm**
0	13	12	8	>6	>3	>0
5	13	12	8	>6	>4	>3
10SS	13	12	8	>6	>3	>0
20SS	13	12	8	>6	>6	>4
30SS	13	12	9	7	>6	>5
0	13	12	8	7	>5	>4
15	13	12	8	>6	>4	>3
15SS	13	12	9	7	>6	>4
30	12	11	8	>6	>3	>3
30SS	13	12	9	>6	>3	>3
45	12	11	8	>6	>0	>0
45SS	12	11	8	>5	>4	>4
60	12	11	8	>4	>3	>0
60SS	12	11	8	>6	>5	>0
75	12	11	7	>5	>0	>0
75SS	12	11	8	>6	>4	>0
0	11	10	8	>4	>0	>0
2	12	11	8	>5	>3	>0
5	11	10	7	>5	>4	>0
15	12	11	8	>6	>4	>3
30SS	13	12	9	8	7	>6
45	13	11	9	7	>6	>4
60SS	13	12	10	9	8	7
75	13	12	10	9	8	7
90	13	12	10	9	9	8
105	14	13	11	10	9	8
120SS	13	12	11	10	9	8
135	14	13	11	9	8	7
150SS	12	11	9	8	7	>6
0	17	16	14	13	13	12
2	17	16	13	12	12	11

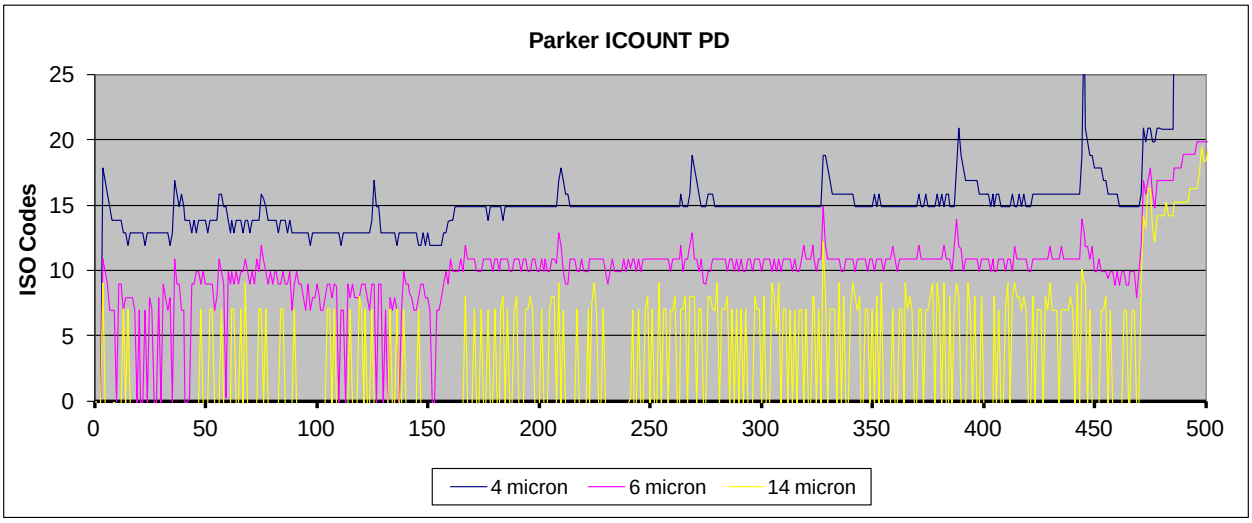
JP-8+100 40:1 Dilution (Test date 12/3/2015)
New Batch of +100 Additive

	Seta: ISO 4406 Codes					
	≥ 4 µm	≥ 6 µm	≥ 14 µm	≥ 21 µm	≥ 25 µm	≥ 30 µm
0	12	11	7	6	5	5
5	12	10	7	6	5	4
10SS	13	12	10	8	6	5
20SS	13	12	9	8	7	5
30SS	13	12	9	8	7	6
0	12	11	9	7	6	4
15	11	10	8	7	6	5
15SS	12	11	9	7	5	5
30	11	10	8	7	5	4
30SS	11	10	7	6	5	0
45	10	9	6	6	5	4
45SS	11	9	7	6	5	0
60	10	9	7	6	5	4
60SS	11	9	6	6	5	4
75	9	8	7	5	4	0
75SS	10	9	7	6	5	4
0	10	8	6	5	4	0
2	9	8	6	5	4	0
5	10	9	7	5	4	0
15	12	11	9	7	6	4
30SS	12	11	9	8	6	5
45	12	11	9	8	7	6
60SS	13	12	9	8	7	5
75	13	12	10	8	7	6
90	13	12	10	9	7	6
105	13	12	10	9	7	6
120SS	13	12	10	9	8	6
135	13	12	10	9	8	7
150SS	13	12	10	9	8	7
0	12	11	9	8	6	5
2	17	16	13	11	11	10

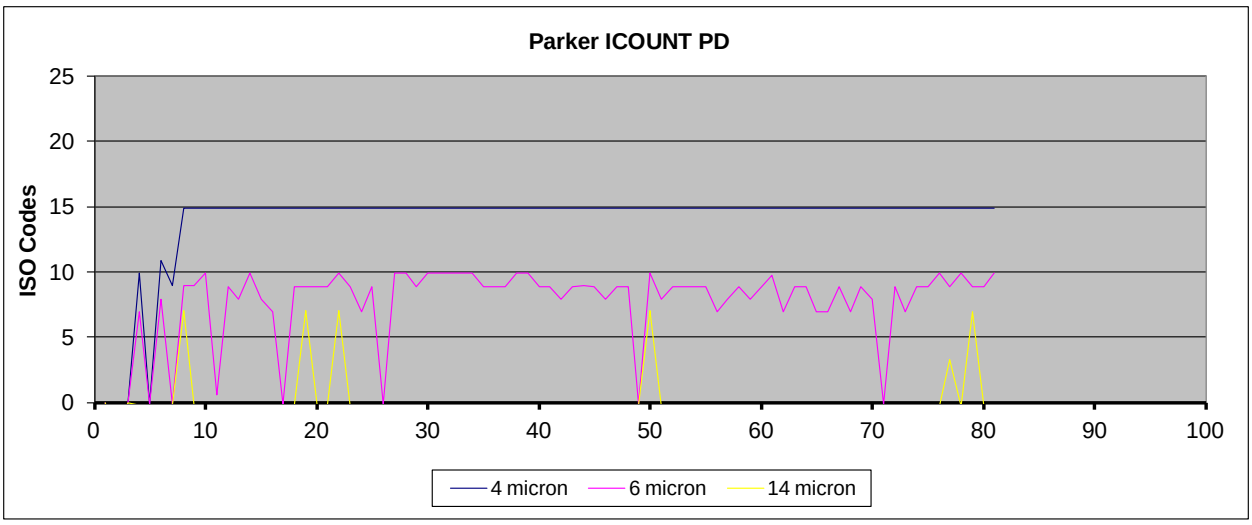
JP-8+100 40:1 Dilution (Test date 12/3/2015)
New Batch of +100 Additive



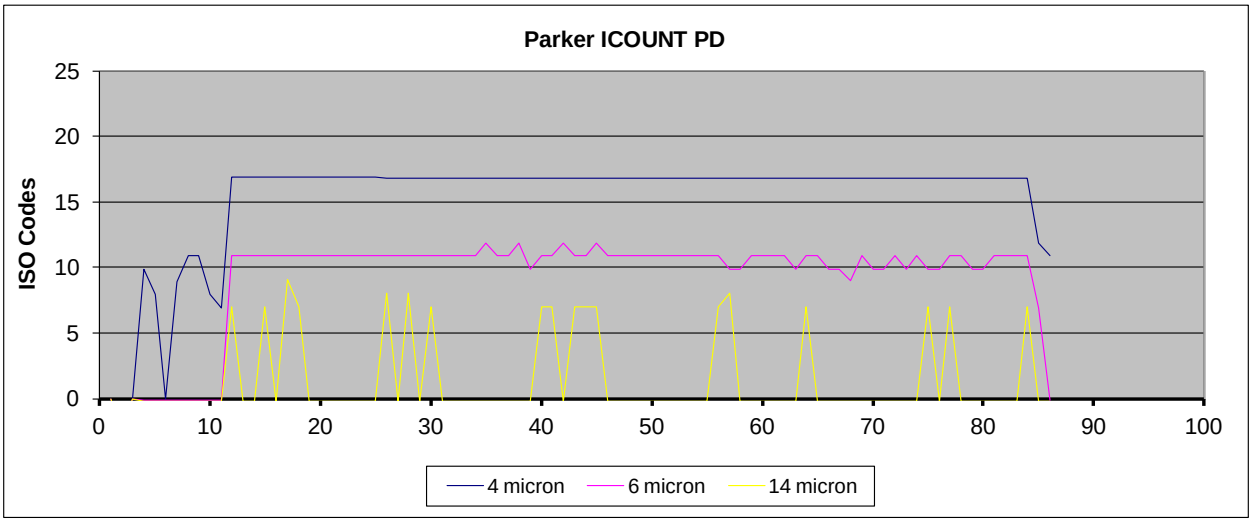
Parker iCount EI 1581 results for DoD test with JP-8+100, 10:1 dilution



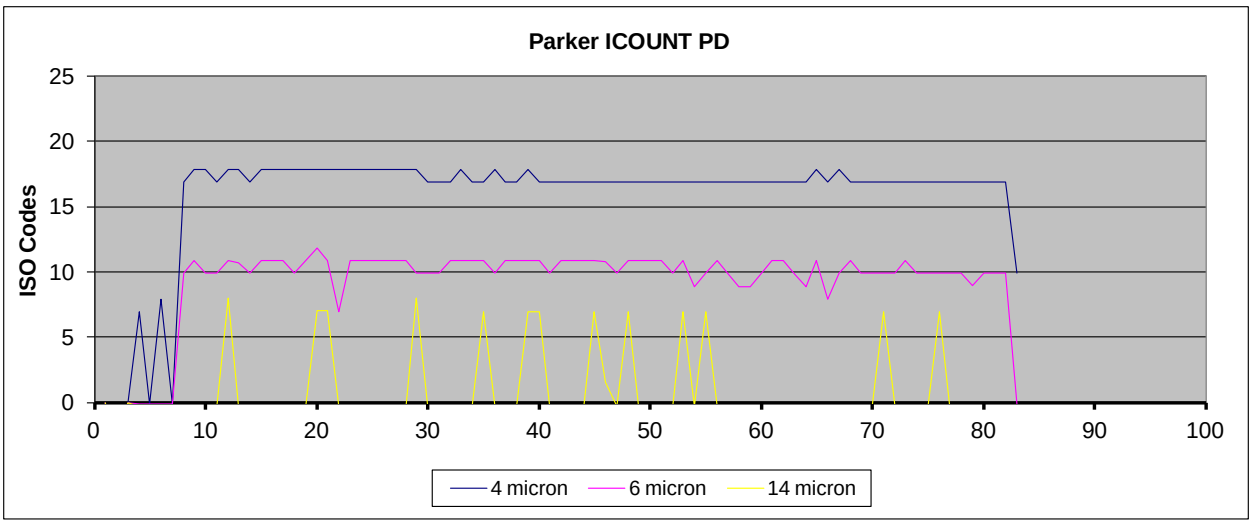
Parker iCount EI 1581 results for DoD test with JP-8+100, 5:1 dilution



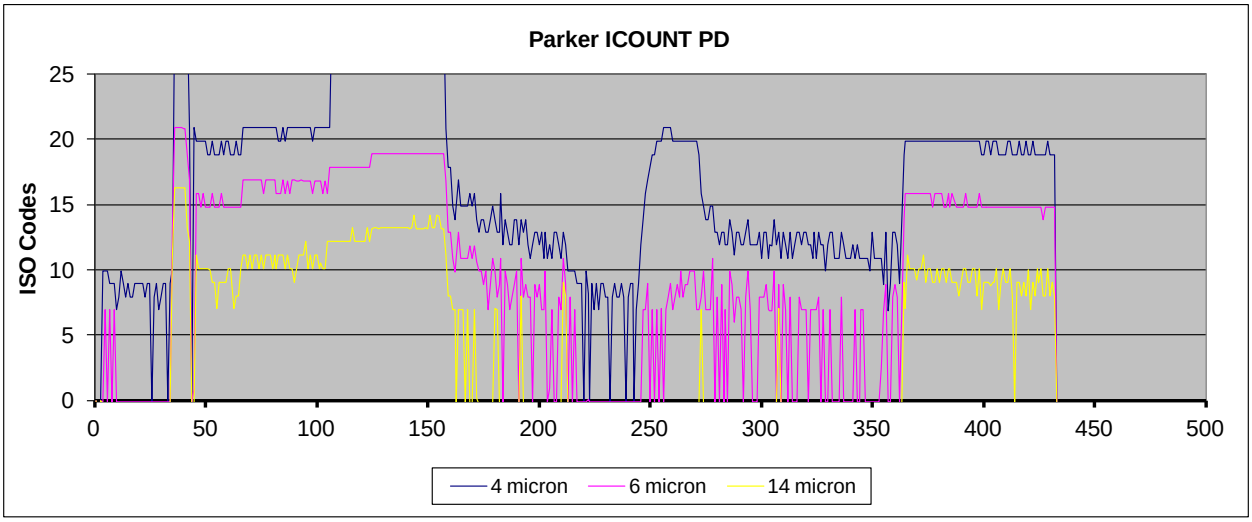
Parker iCount, 0.25 mg/L ISO 12103-1 A-3 medium test dust



Parker iCount, 1.0 mg/L ISO 12103-1 A-3 medium test dust

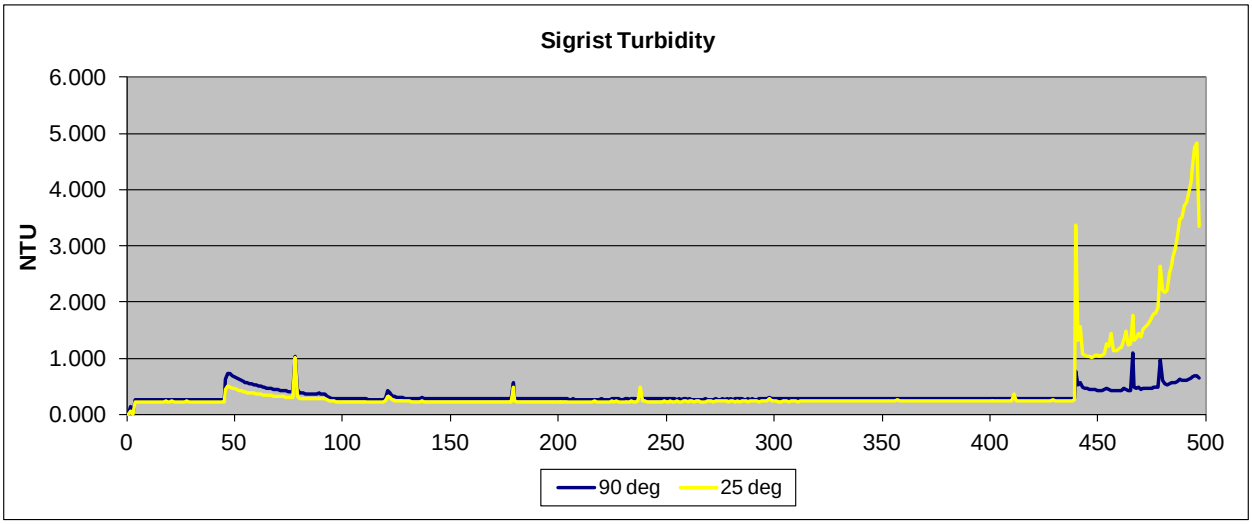


Parker iCount, 1.0 mg/L ISO 12103-1 A-2 fine test dust

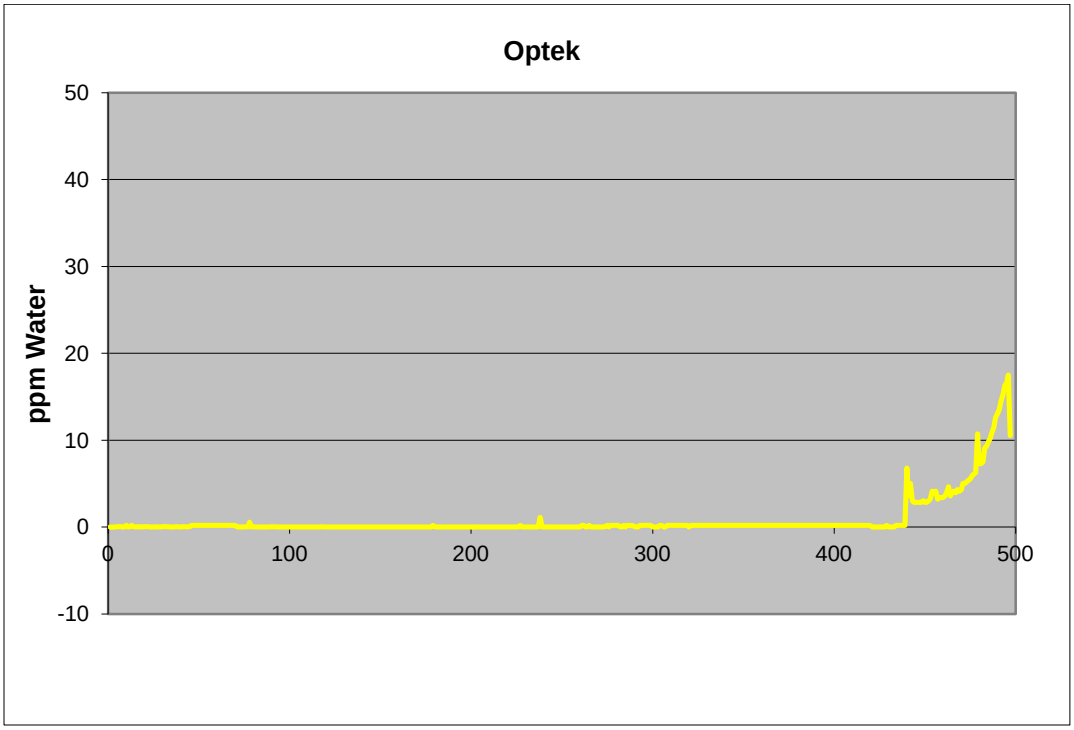


Parker iCount 3 ppm free water

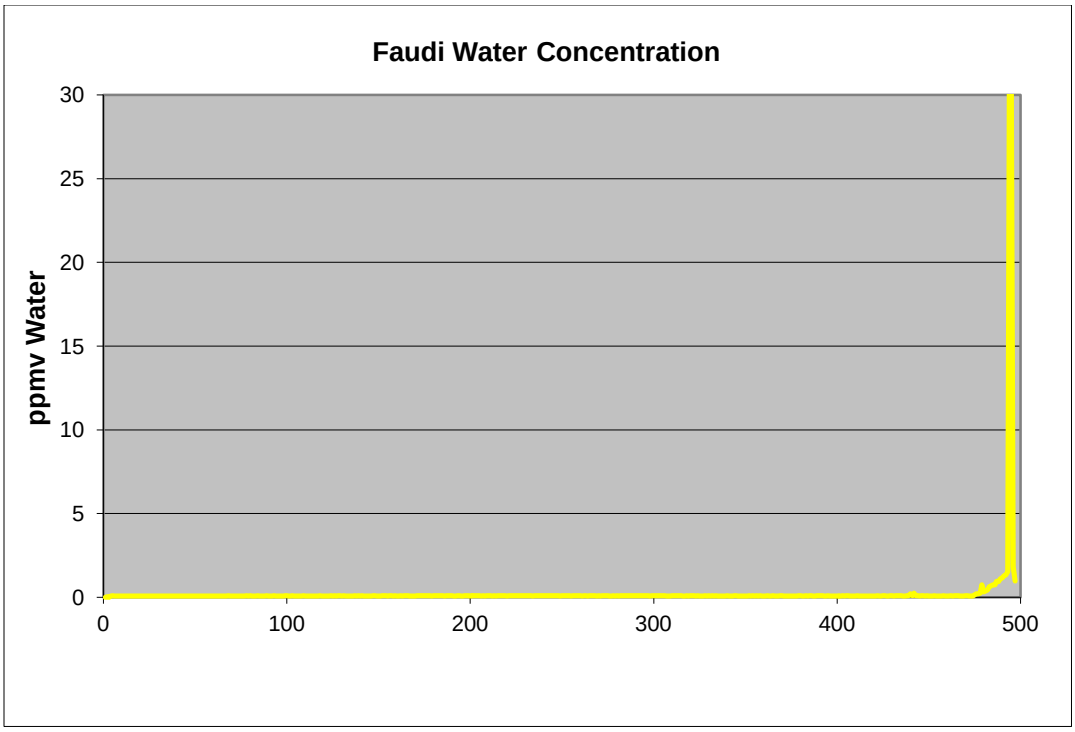
APPENDIX C
OTHER SENSORS



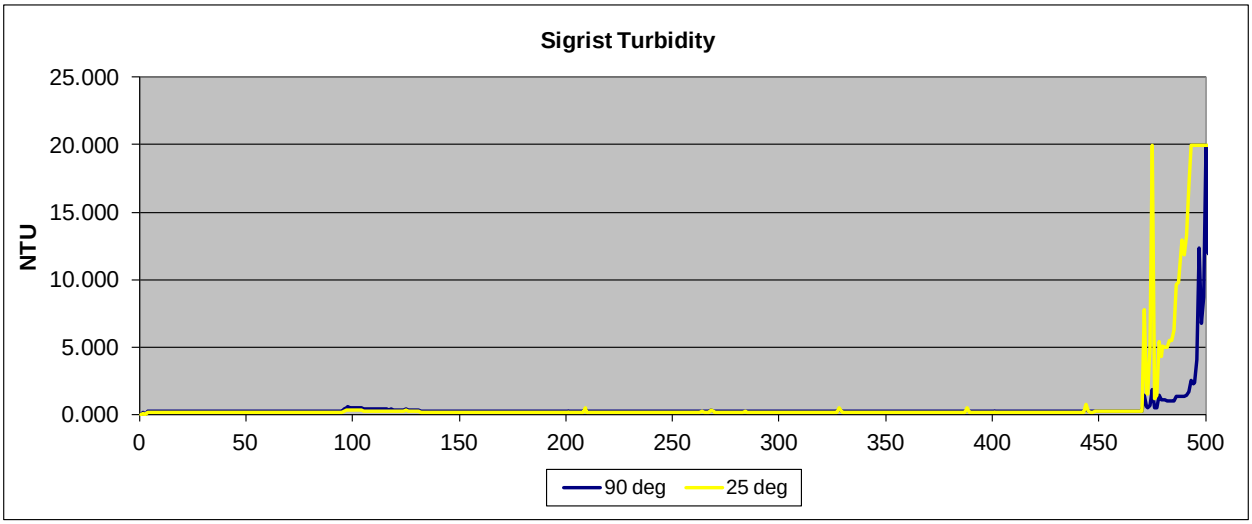
Sigrist EI 1581results for DoD test with JP-8+100, 10:1 dilution



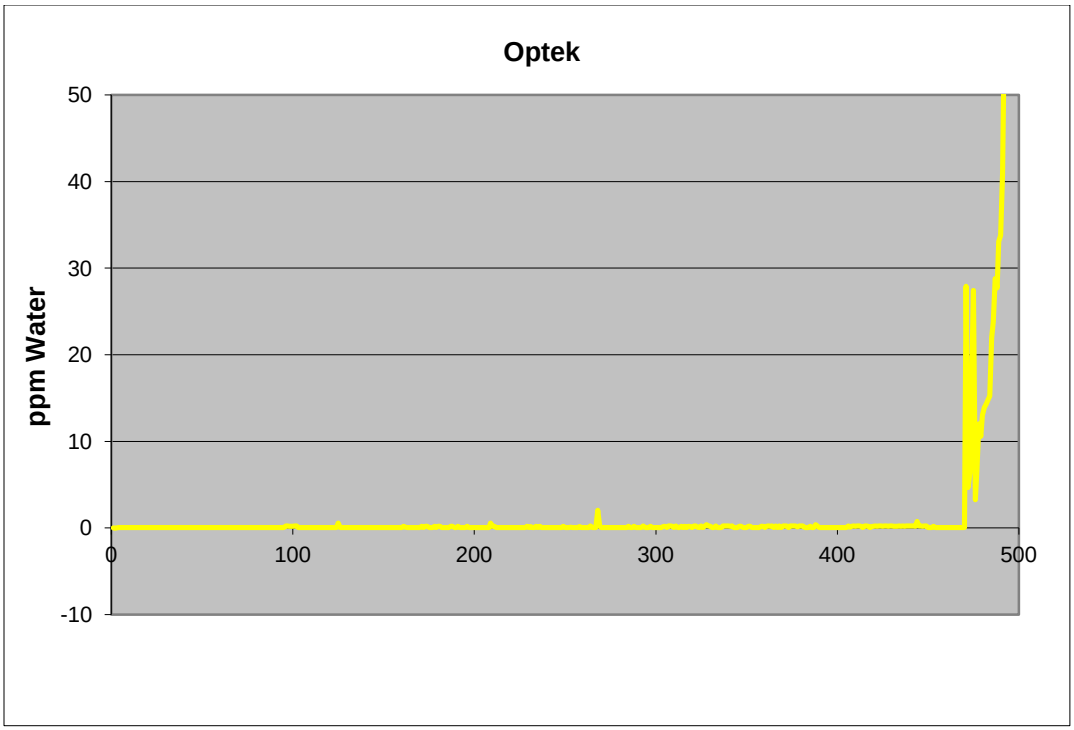
Optek EI 1581 results for DoD test with JP-8+100, 10:1 dilution



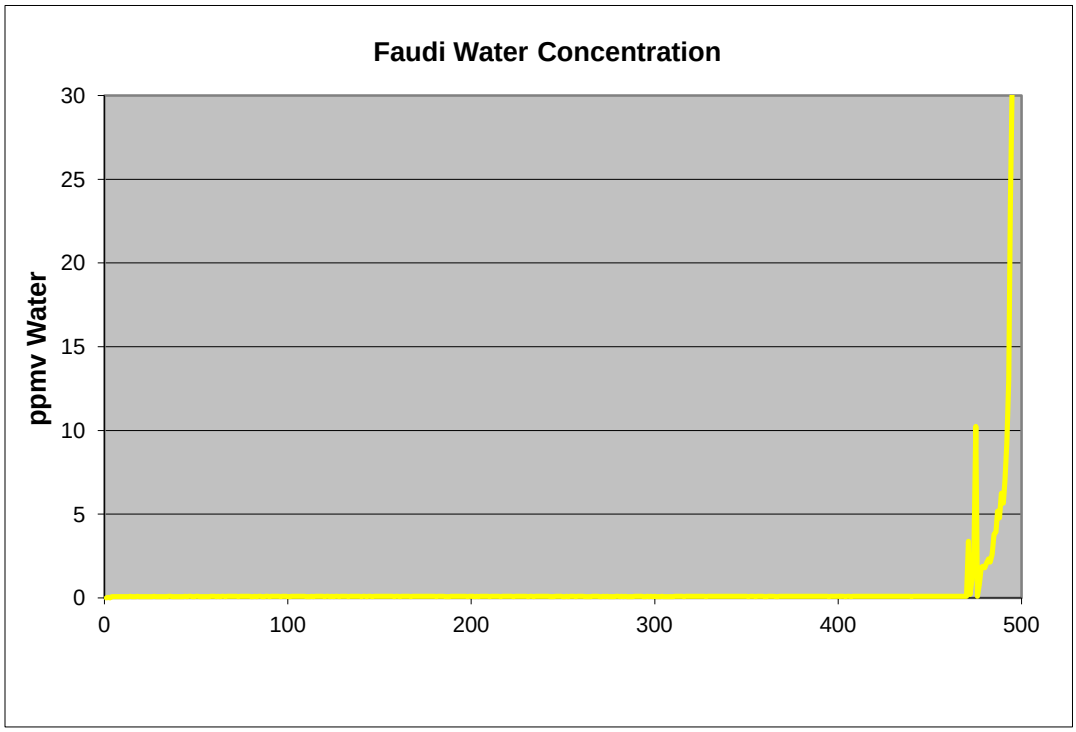
Faudi AvGuard EI 1581 results for DoD test with JP-8+100, 10:1 dilution



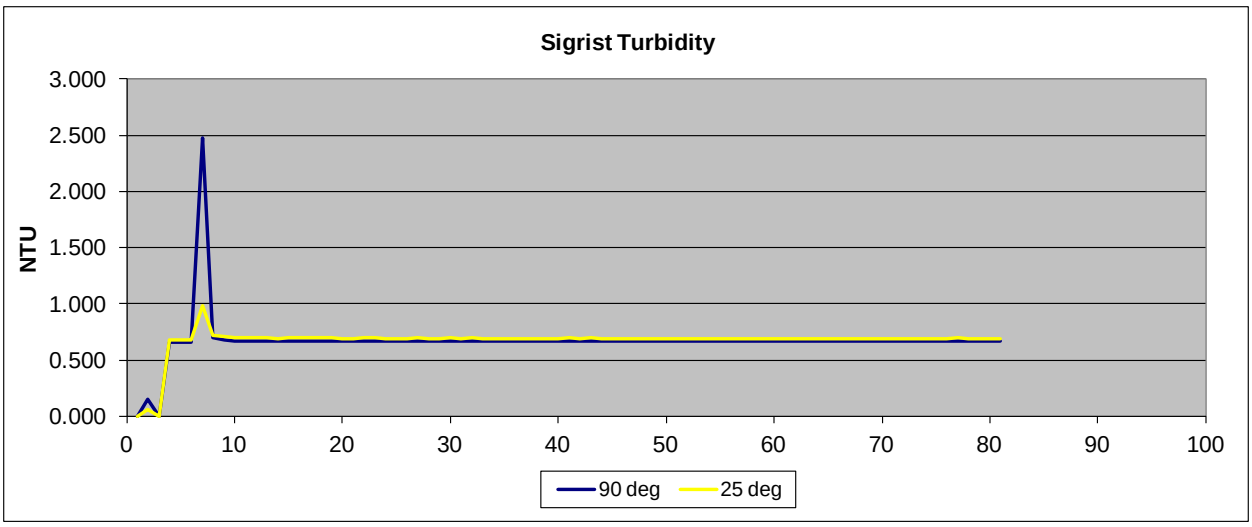
SigristEI 1581 results for DoD test with JP-8+100, 5:1 dilution



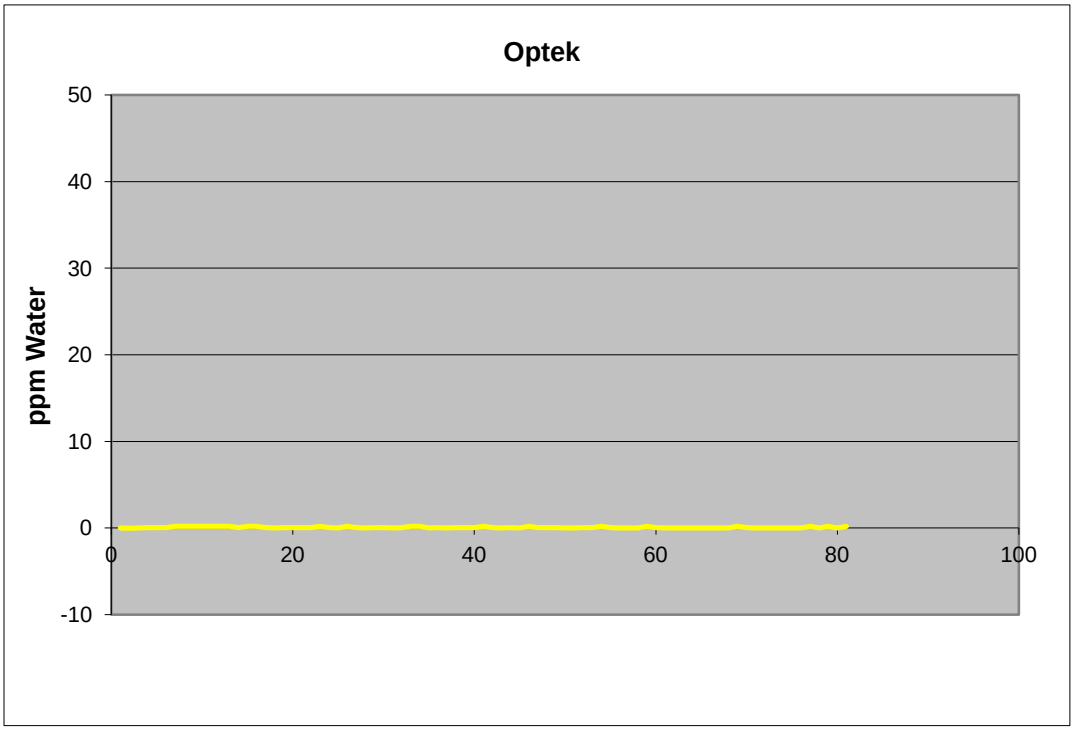
Optek EI 1581 results for DoD test with JP-8+100, 5:1 dilution



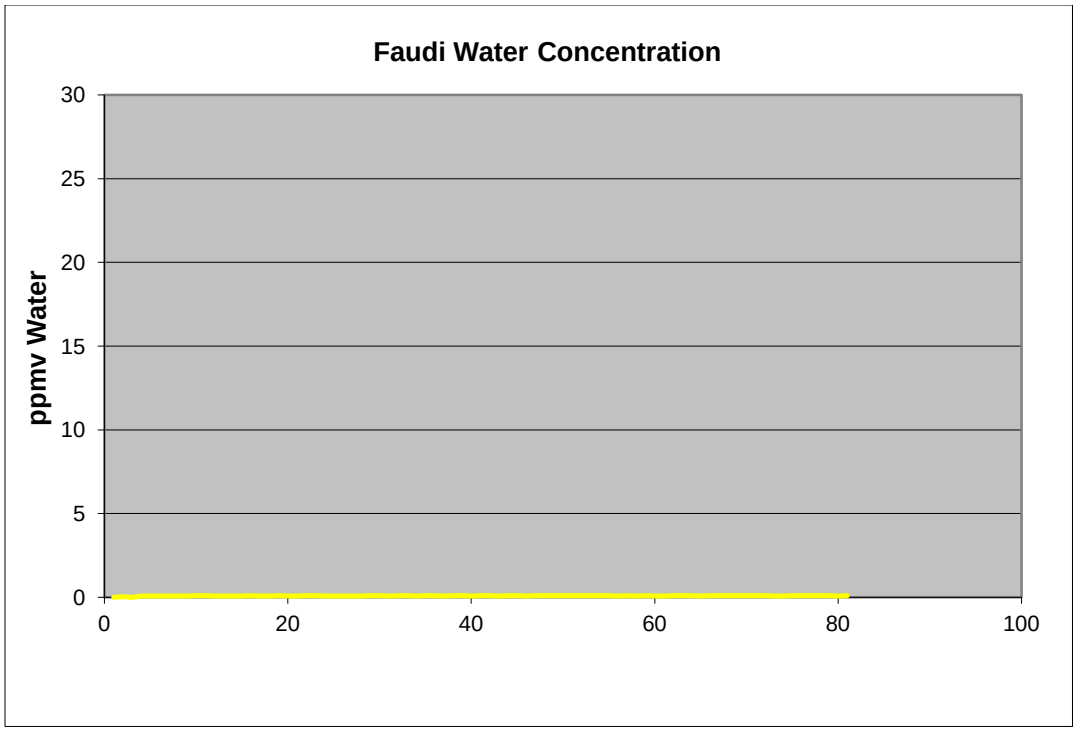
Faudi AvGuard EI 1581 results for DoD test with JP-8+100, 5:1 dilution



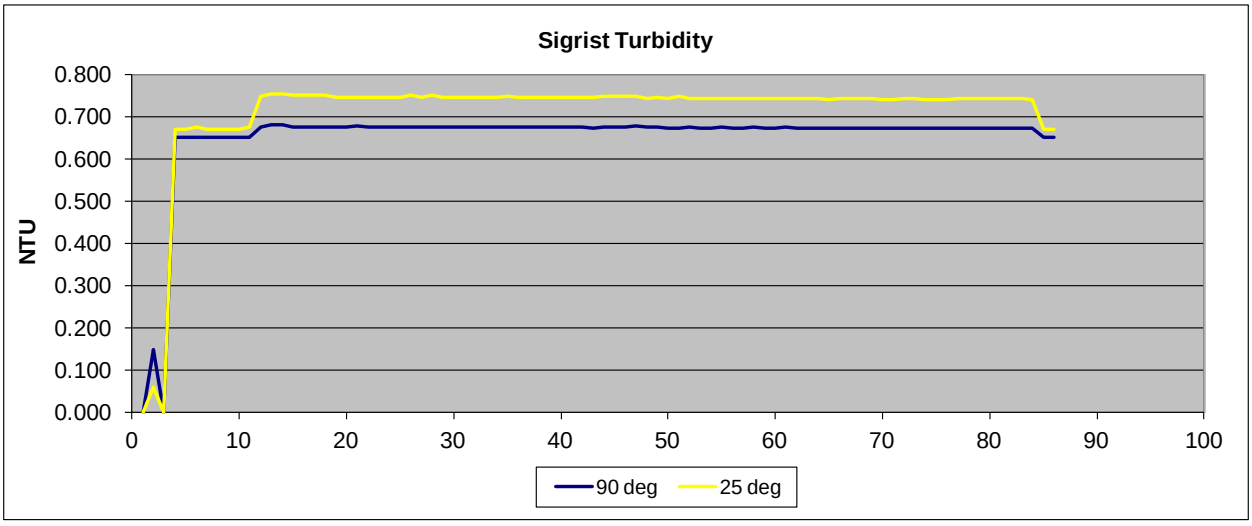
Sigrist, 0.25 mg/L ISO 12103-1 A-3 medium test dust



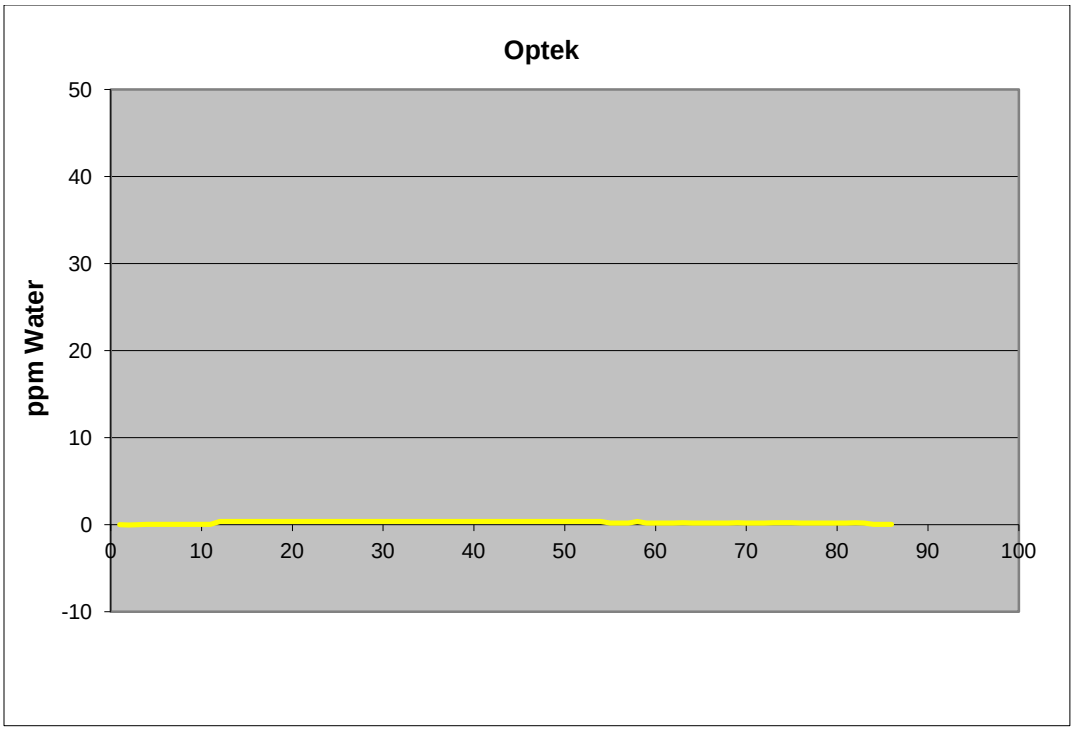
Optek, 0.25 mg/L ISO 12103-1 A-3 medium test dust



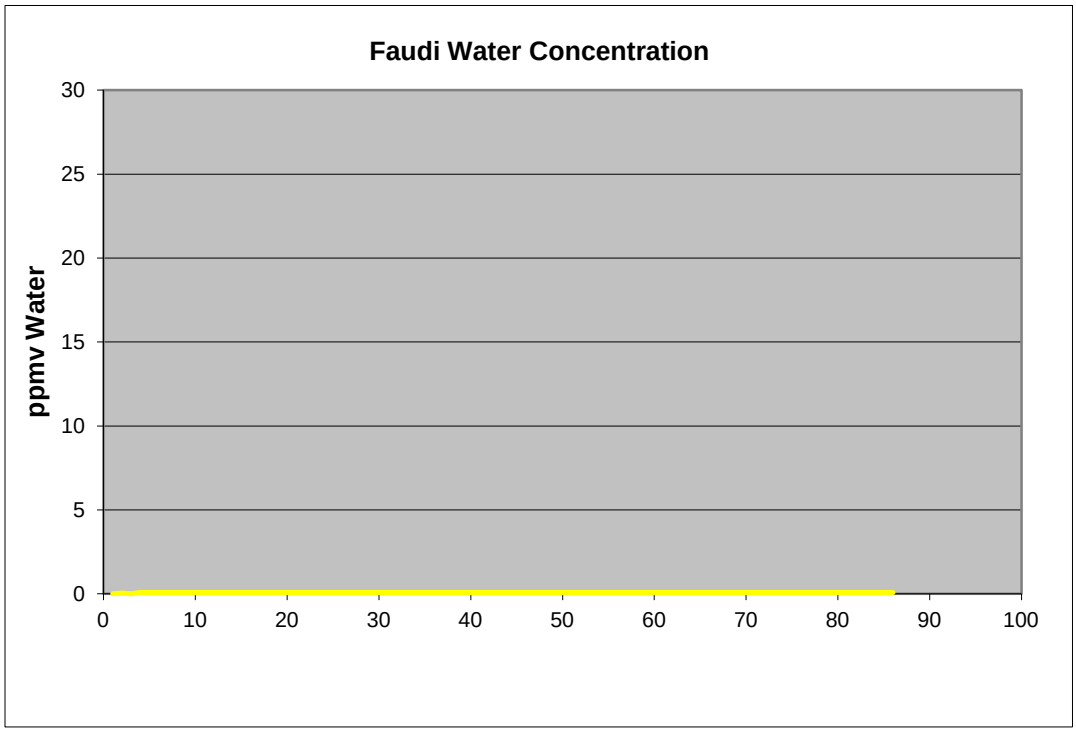
Faudi AvGuard, 0.25 mg/L ISO 12103-1 A-3 medium test dust



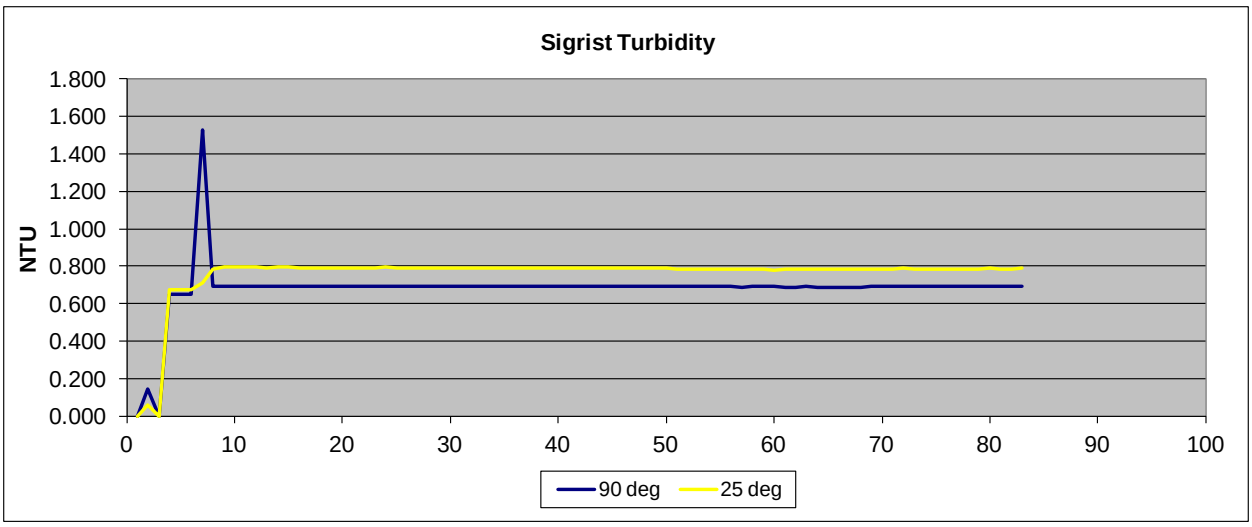
Sigrist, 1.0 mg/L ISO 12103-1 A-3 medium test dust



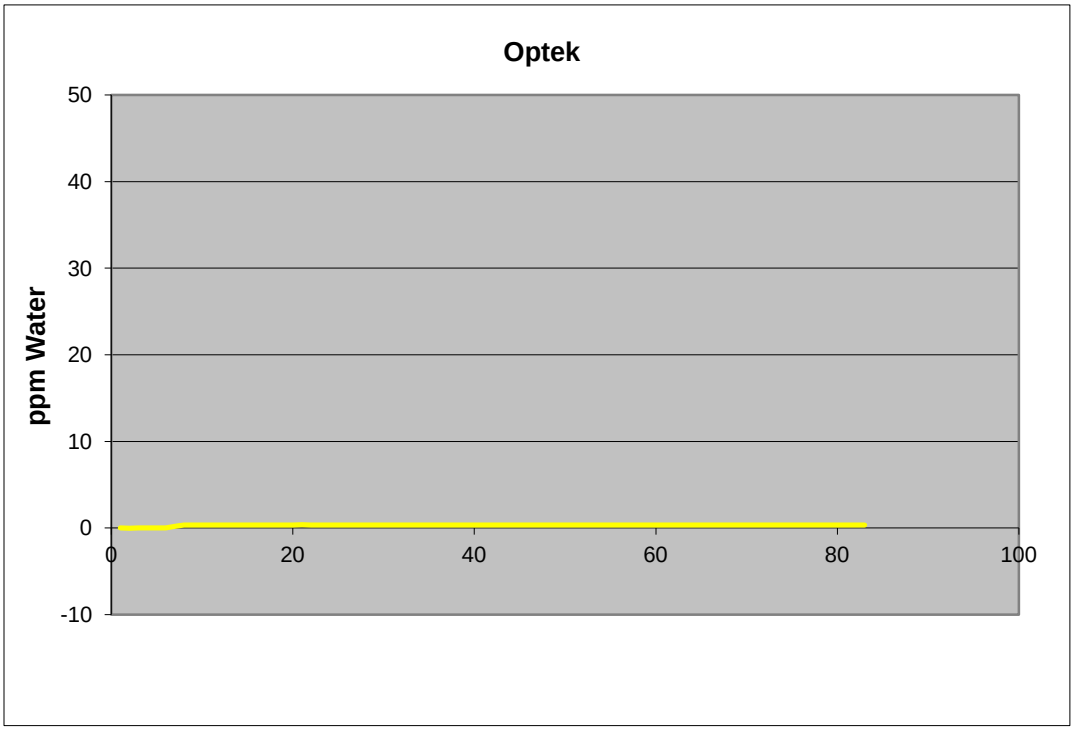
Optek, 1.0 mg/L ISO 12103-1 A-3 medium test dust



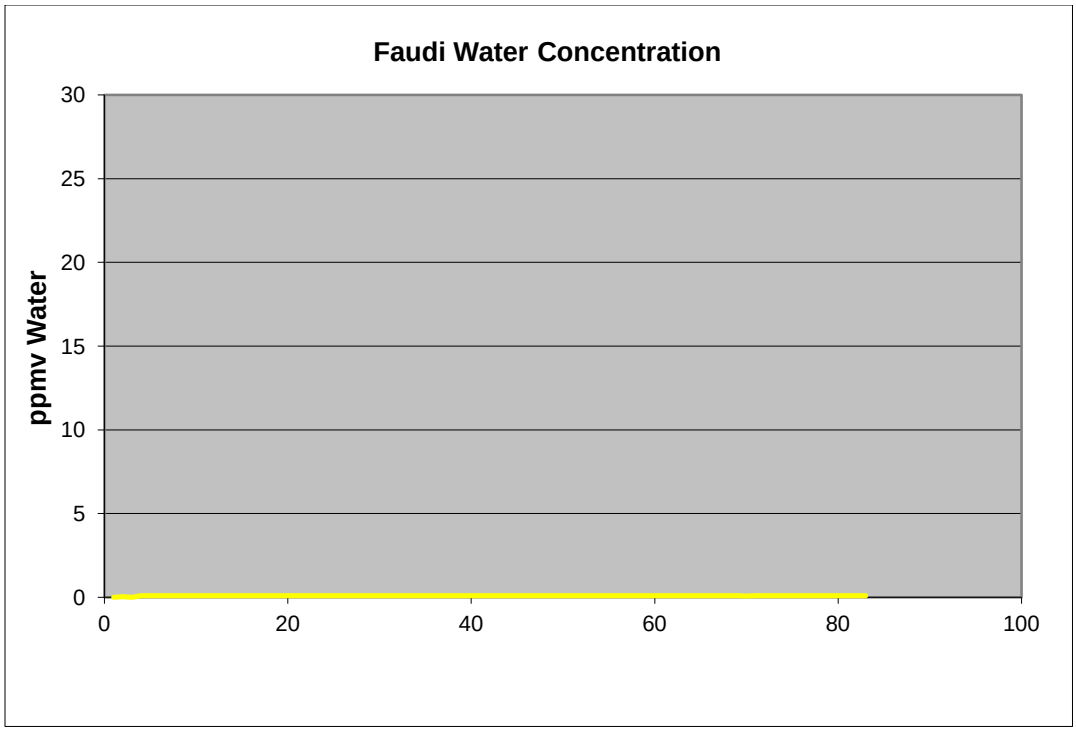
Faudi AvGuard, 1.0 mg/L ISO 12103-1 A-3 medium test dust



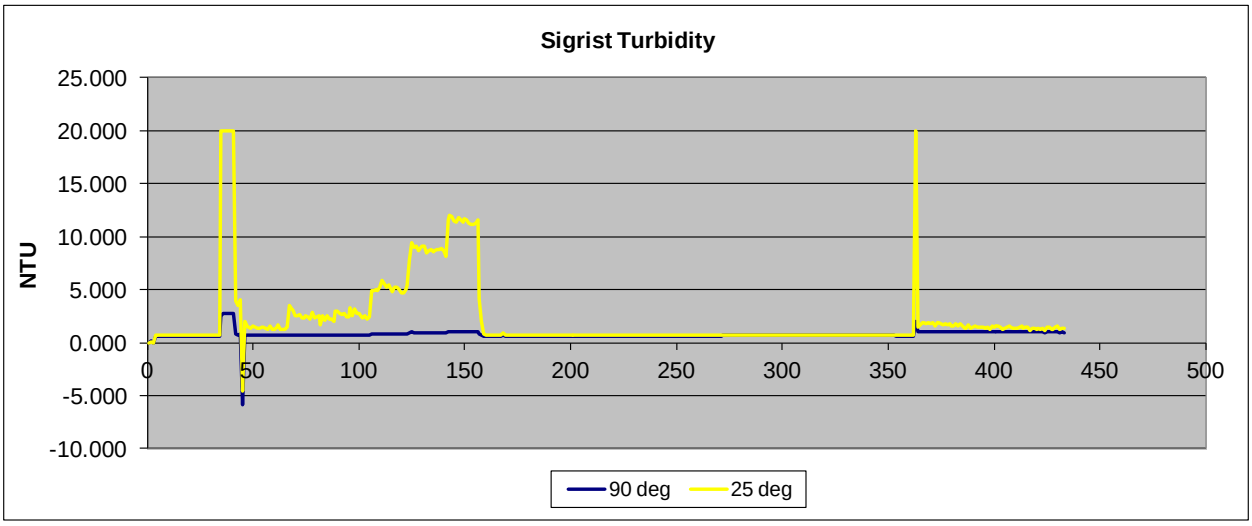
Sigrist, 1.0 mg/L ISO 12103-1 A-2 fine test dust



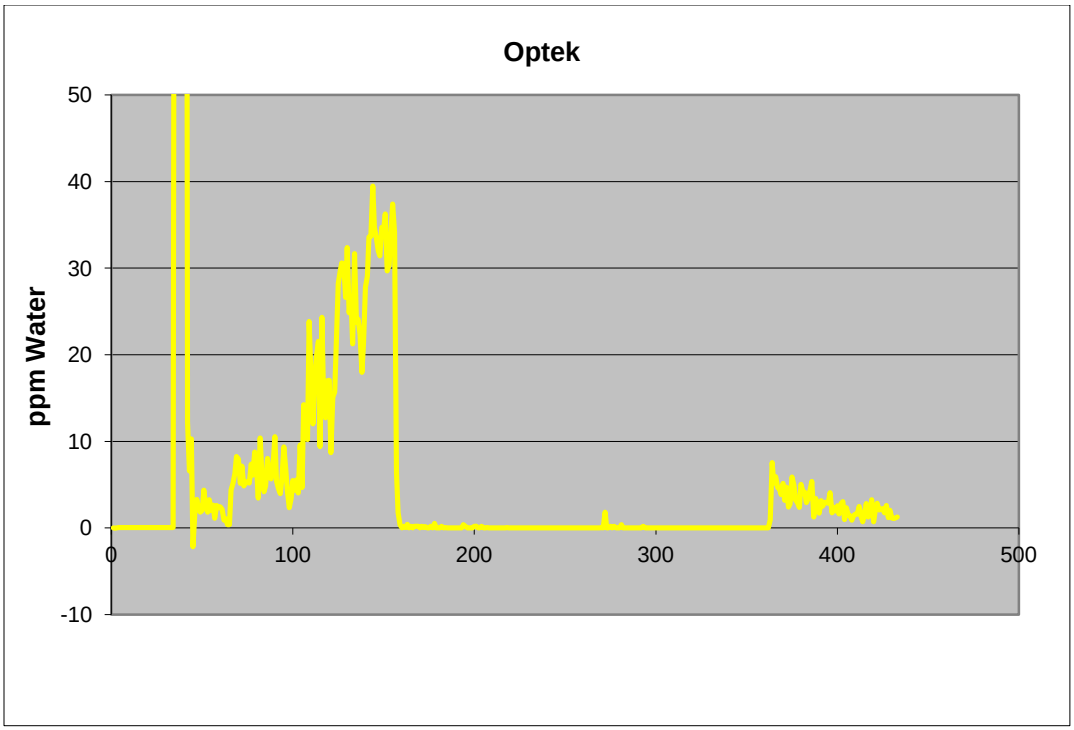
Optek, 1.0 mg/L ISO 12103-1 A-2 fine test dust



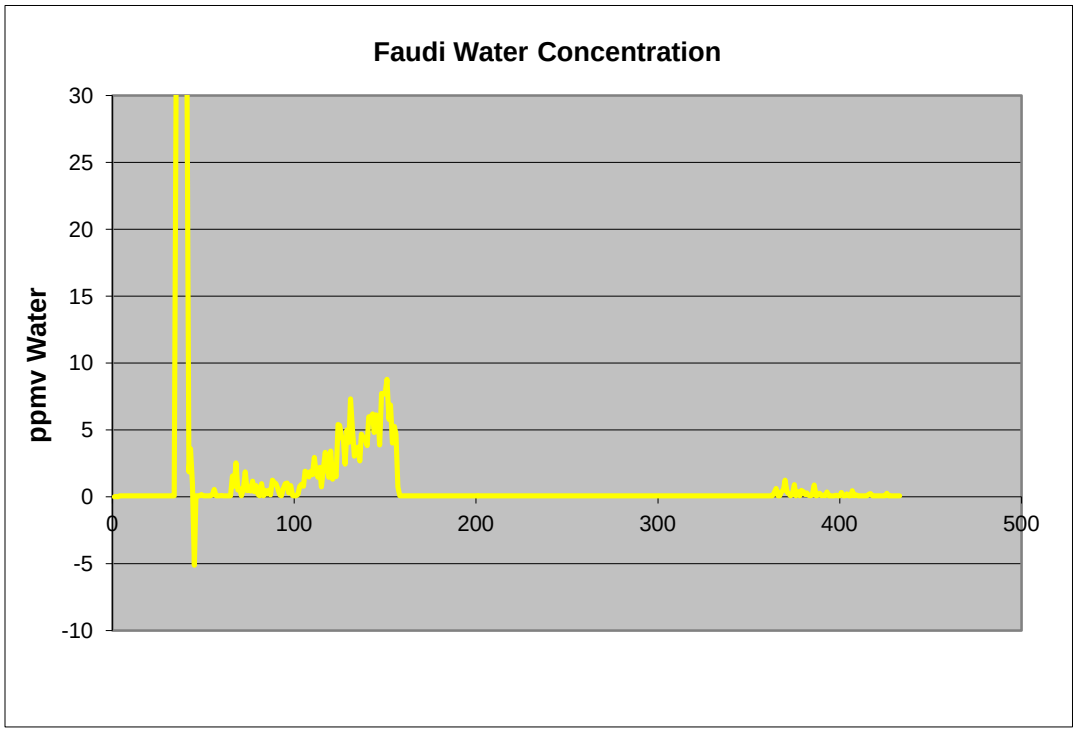
Faudi AvGuard, 1.0 mg/L ISO 12103-1 A-2 fine test dust



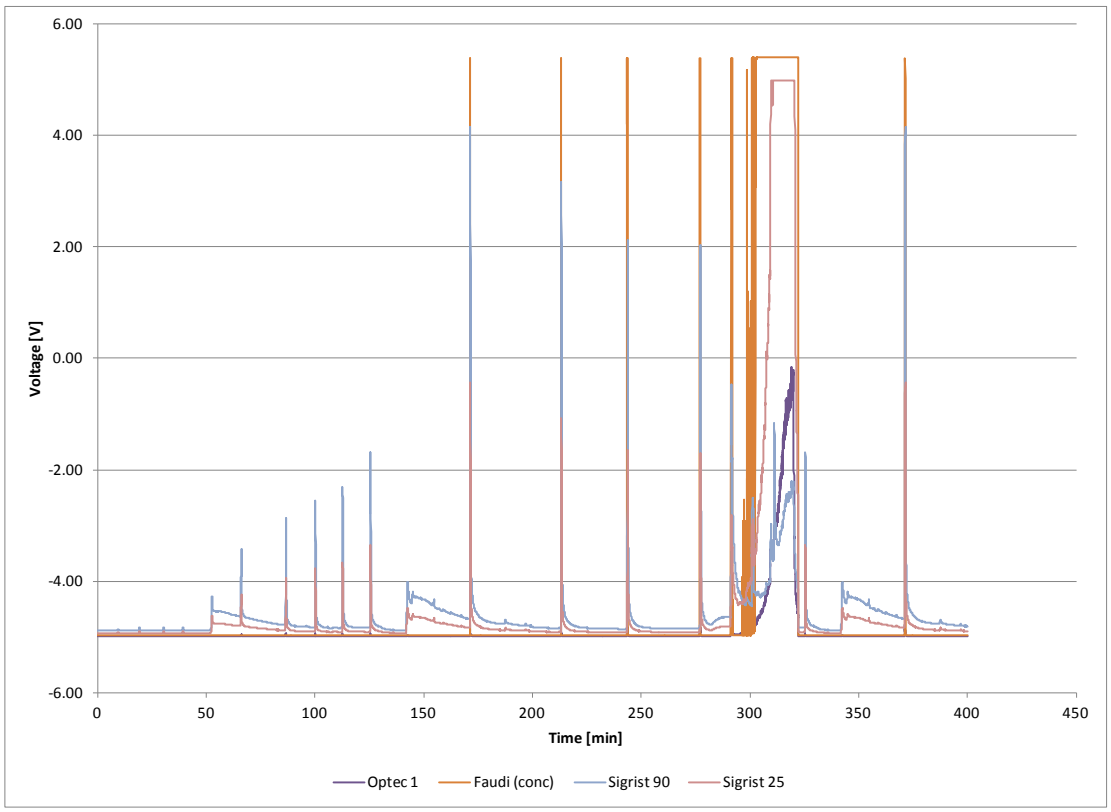
Sigrist, 3 ppm free water



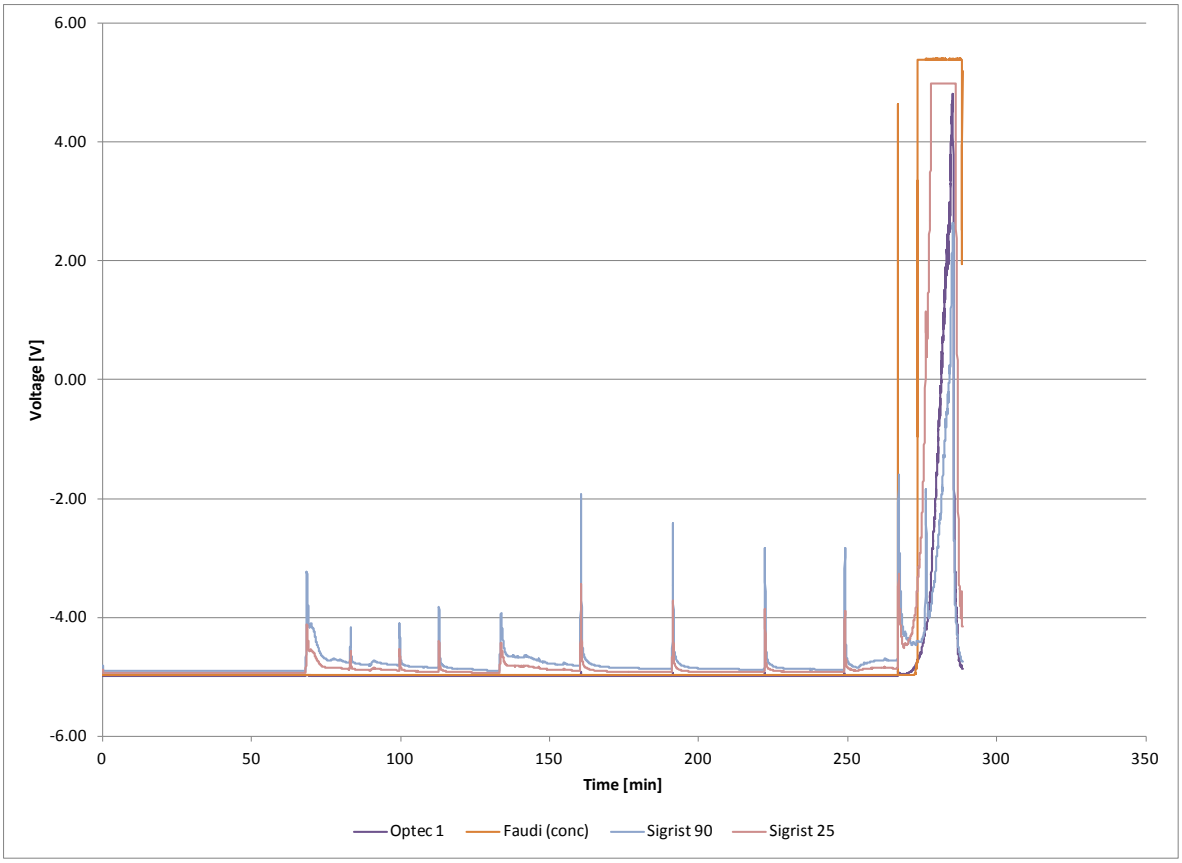
Optek, 3 ppm free water



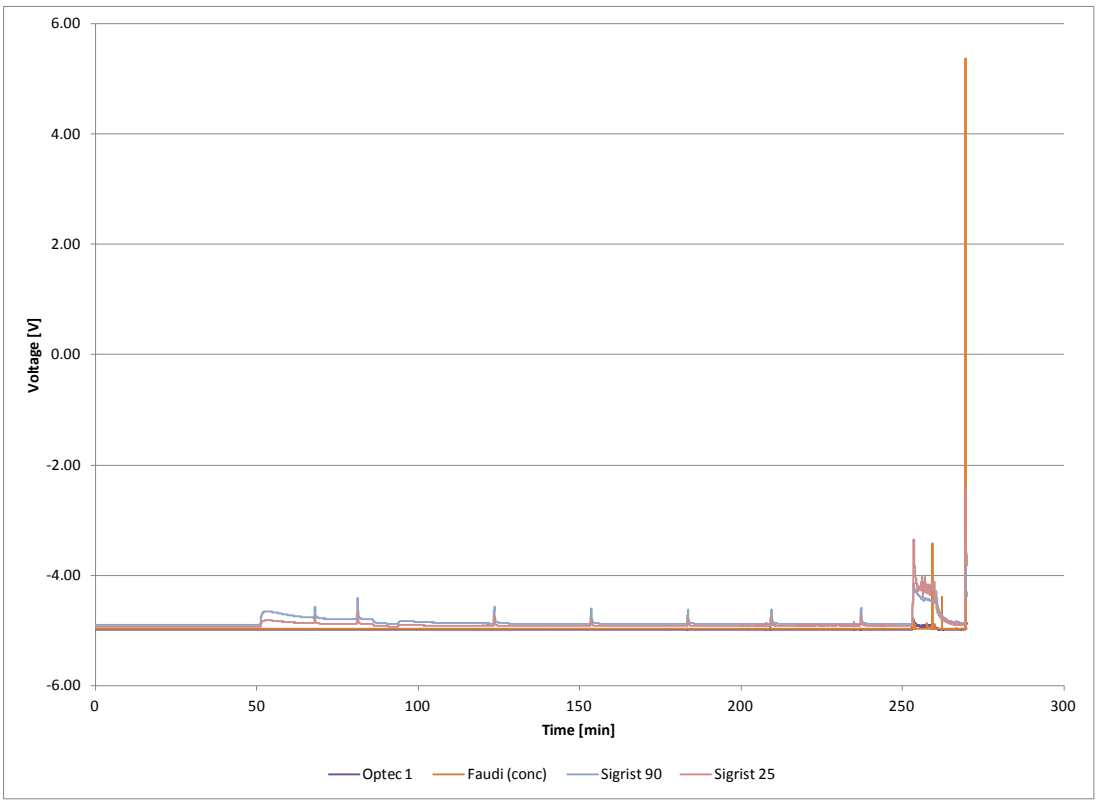
Faudi AvGuard, 3 ppm free water



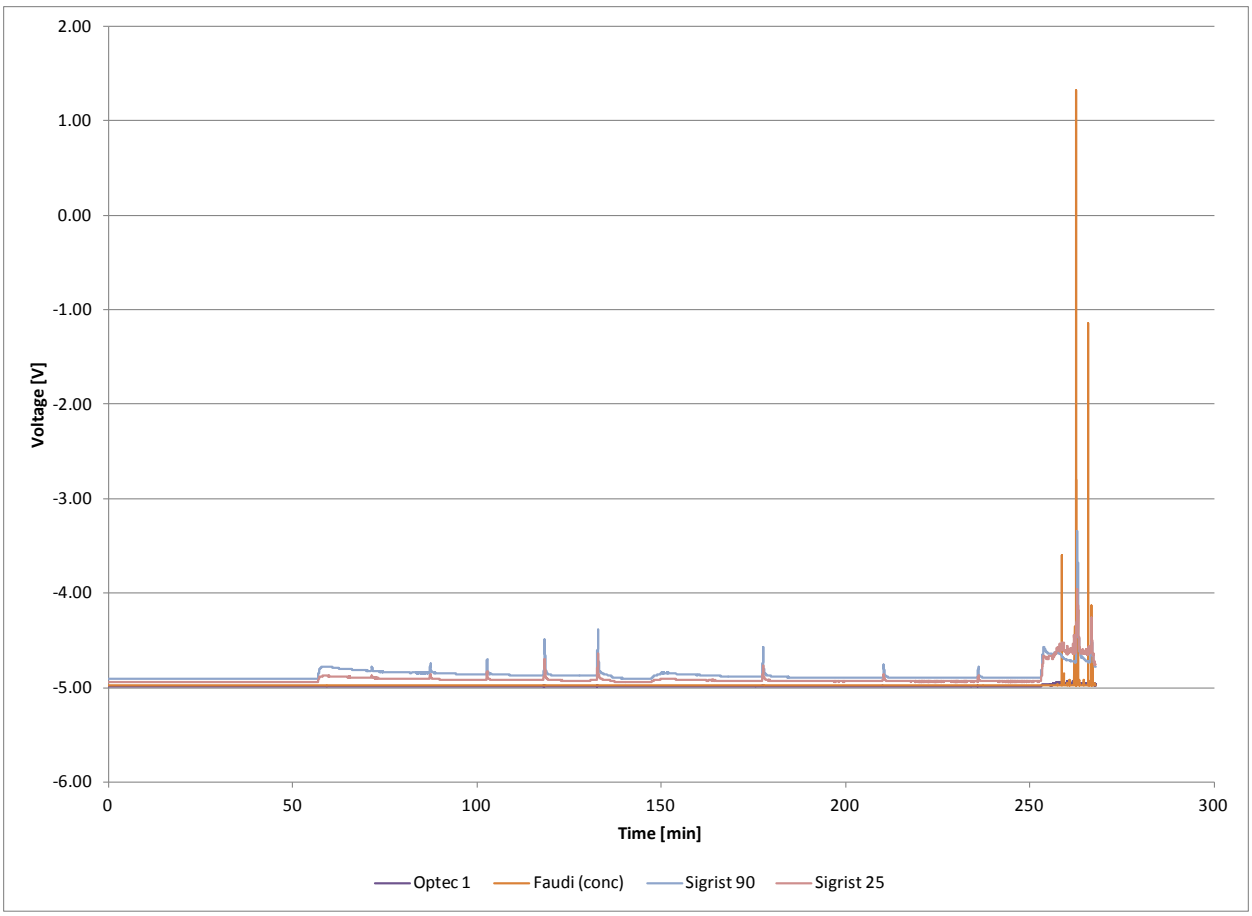
EI 1581 5th Edition M Category Test – JP-8+100 (1:1 dilution)
Electronic Sensors Raw Data



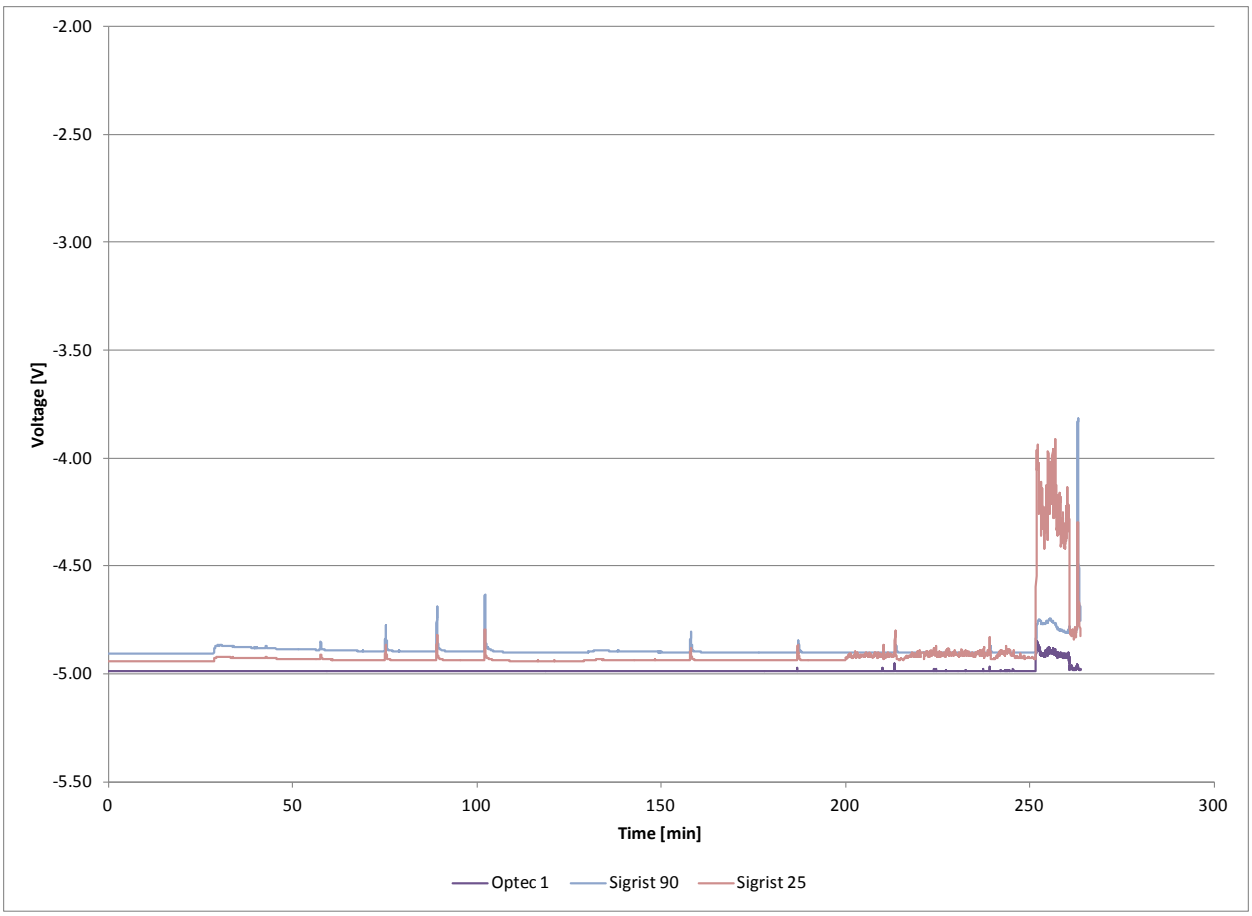
EI 1581 5th Edition C Category Test – JP-8+100 (5:1 dilution)
Electronic Sensors Raw Data



EI 1581 5th Edition M Category Test – JP-8+100 (10:1 dilution)
Electronic Sensors Raw Data



EI 1581 5th Edition M Category Test – JP-8+100 (20:1 dilution)
Electronic Sensors Raw Data



EI 1581 5th Edition M Category Test – JP-8+100 (40:1 dilution)
Electronic Sensors Raw Data